

A BRIEF PHYSIOTHERAPY MANUAL

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SECOND EDITION.
Thoroughly revised.

CHICAGO
NEW MEDICINE PUBLISHING CO.,
25 E. Washington St.

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AUTHOR'S NOTE.

This book is primarily for the use of physicians taking the Author's Lecture Course and Clinic in Electrotherapy.

It is difficult for the listener to take notes which are sufficiently copious and accurate for future reference for which reason the fundamental part of the course is hereby set forth. Many of the explanations necessarily are omitted, but will be recalled from the data given in the text.

The author has given particular attention in his Lecture Courses to methods of simplifying the work and making the facts more easily understood. To this end various original figures, graphs, tables, etc., have been devised. Because these are being daily employed by the author, attention is called to the fact that they are protected by copyright, and their use by other authors or lecturers, **without permission**, will be vigorously prosecuted.

There are many different methods of physical treatment employed and each has its adherents. I have given

the technique which I prefer, or which experience has shown to be reliable. At times other methods are referred to but as this is apt to prove confusing, I have given usually a single method.

N. M. E.

Marshall Field Annex, Chicago.

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CHAPTER ONE.

Introduction, Definitions and Classification.

The War and Physiotherapy. The war accomplished a great deal for the cause of Physiotherapy, through convincing many physicians of its value who never would have been convinced under civil conditions. It has also afforded us statistics of real value covering the percentage of successful results obtainable in many diseases.

The U. S. Government also came to appreciate the value of physical measures of treatment so that all government hospitals now are equipped with apparatus for giving these treatments.

The Leading Universities are rapidly establishing courses of instruction for the more thorough study of these useful methods and The American Medical Association has given its official recognition.

Scientific Electrotherapy. Progress in Medical Electricity and in Physiotherapy has been as great, proportionately, as that in commercial electricity, and the

physician who does not take heed, soon will find himself left behind by his more progressive competitors.

The Author is endeavoring to "do his bit" in establishing Physiotherapy on a sound scientific foundation. Originally purely empirical methods were necessary, but now that the different modalities are understood and their definite action classified, we are on a different footing.

Empiricism always will be required, but with the physiological action of the various modalities understood, it will be intelligent and scientific empiricism.

The Laws Governing Electricity are as definite and exact as those of mathematics and it may be employed with assurance of a definite result, if used as indicated by the physiological action of the various forms.

Electricity is Not a "Cure-All" nor is it a Practice of Medicine, but it does some things better than they can be done by any other therapeutic agency. In other conditions it is as good, although not necessarily superior to usual methods, giving an added advantage to the physician and in no-wise interfering with the action of other remedies. In still other conditions it has so far proved to be of little or no value.

It is therefore, important that the physician shall inform himself of its scope, so that his patients may have the benefit.

Condemnation of a method, when the physician is completely ignorant on the subject, is grossly unfair. Thorough investigation will convince the most skeptical.

Author's Method. It is my endeavor to teach the action of the various currents, after which their choice and application will be apparent. When certain pathology presents itself, the physician will know that the action of a particular form of electricity will be indicated, to try and overcome the pathological condition existing. He will understand also the combining of two or more modalities each to do its particular part.

Diagnosis and Pathology are equally important, whatever therapeutic agency is employed. It is so in Electrotherapy, and the better these subjects are understood, the better will be the results. This is not enough, however. Physiotherapy also must be understood, and apparatus employed giving true and characteristic currents of sufficient volume.

One cannot buy a machine, learn how to turn it on and off, and set out to practice Electrotherapy. The absurdity of this is apparent.

Protons and Electrons. Ions are minute particles of electricity. Those which carry a positive charge are known as protons; those having a negative charge, electrons. An atom is composed of one or more central or

nuclear protons with one or more electrons revolving around it, somewhat as the earth travels around the sun.

Electrons, when disembodied, travel at a high rate of speed, from 600 miles a second up to approximately that of light (186,000 miles per second). Unless they travel at the rate of at least 600 miles a second, they will adhere to the first atom they encounter, otherwise they have the property of passing through the atom and through bodies considered opaque.

This is in line with the newest conception of matter. Electrons have been measured. Each of our chemical elements contains a definite number of protons and electrons. If hydrogen is taken as 1, helium represents 2, lithium 3, and so on. Uranium has the highest number, 92, and therefore the greatest number of electrons. Up to 1926 only 87 chemical elements had been isolated and in the first edition of this book I stated that since there were five missing numbers in the scale between 1 and 92, five additional elements ultimately would be discovered. In March 1926, Dr. Hopkins of the University of Illinois announced the discovery of No. 61 which has been named illinium. In a bubble of hydrogen gas there are billions of atoms and an electron is fully a thousand times smaller than the smallest atom.

It has been said that if this bubble of hydrogen gas were magnified to the size of the earth, an atom in com-

parison would be the size of a tennis ball and an electron the size of a pin-head.

All chemical elements are either positive or negative and it is because of this and the attraction held for one another of unlike kinds of electricity, that we have any chemical combinations.

Electrical Units. There are some units of measurement in constant use which the physician should understand.

The volt is the unit of pressure; that which tends to move electricity from place to place.

The ohm is the unit of resistance and measures the obstruction offered to the passage of the current. If the volts just equalled the ohms, we would have no current. but as voltage predominates, then current results.

The ampere is the unit of current strength or intensity, the rate of flow. In the minds of many, amperage and current are synonymous, but it is observed that it is only one factor.

The milliampere is $1/1000$ of an ampere and is the medical unit.

The watt is the unit of power and measures the capability or efficiency of electrical apparatus.

One watt equals one volt times one ampere. It is thus seen that the working effectiveness of a machine does not depend on voltage alone, nor on amperage alone, but on a product of these two factors.

746 watts is one electrical horsepower.

Note: When the Latin prefix **milli** meaning one thousand, is used, it signifies to divide by one thousand. Thus a milliampere is one one-thousandth of an ampere; a millimeter one one-thousandth of a meter, etc.

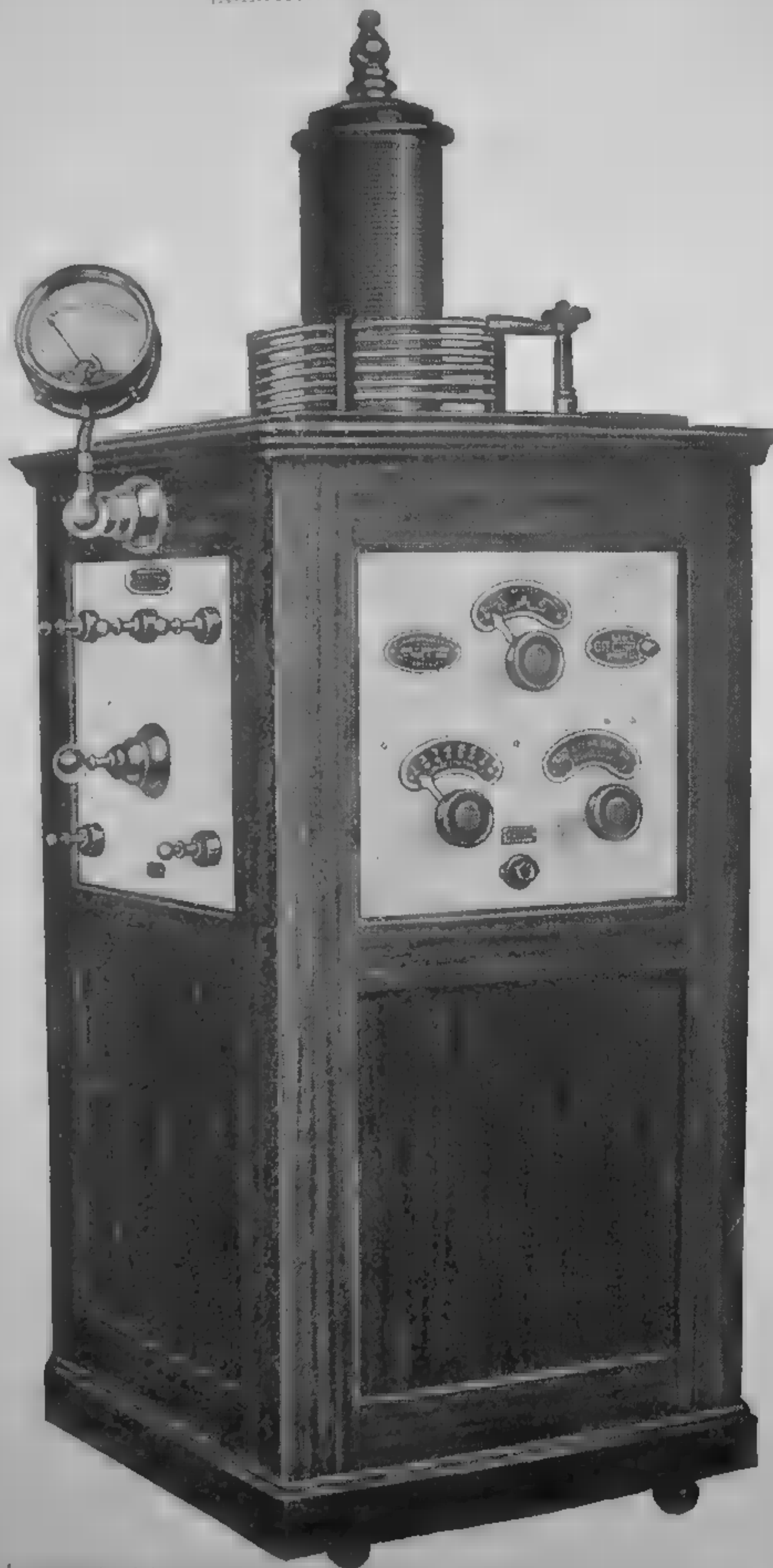
When the Greek prefix **kilo** also meaning one thousand is used, it signifies to multiply by one thousand. Thus, a kilowatt is one thousand watts; a kilometer, one thousand meters, etc.

Need of Good Foundation. In whatever line a man may be interested, he can accomplish good results only when he possesses a thorough basic or fundamental knowledge of his subject. This is particularly true of Electrotherapy and Physiotherapy in general.

A physician will say to me, "I only do nose and throat work, can't I learn the technique for these diseases without bothering with all of this elementary stuff"? If intelligent and scientific work is to be accomplished it makes no difference about the specialty; a thorough knowledge of the basic principles is necessary. When a specialist acquires the knowledge of the action of each form of current, he will then be able to apply it properly not only in those diseases that I give him special technique in, but also in any of the conditions covered by his specialty.

Eberhart's Classification of Electrical Currents.

GALVANIC Chemical because of polarity	{	Positive Pole	{	Acid. Stops hemorrhage. Vaso-constrictor. Hardens tissue and dries discharges. Sedative; relieves pain. Soothes inflammation.			
		Negative Pole	{	Alkaline. Increases bleeding. Vaso-dilator. Softens and liquefies. Irritating. Causes inflammation.			
FARADIC Mechanical	{	Purely stimulating, but causes great irritation with minimum stimulation. Largely superseded by the sinusoidal current.					
SINUSOIDAL Mechanical or exercise current, smooth and sym- metrical	{	Great stimula- tion with slight irrita- tion	{	Alternating Current Group	{	Rapid Sinusoidal Inhibits or obtunds. Interrupted Rapid Regenerates nerve function. Nerve tonic. Surging Sinusoidal Powerful massage (Alternating current for break- Sinusoidal) ing up adhesions and deposits.	
				Galvanic Group	{	Slow Sinusoidal Tonic to muscles and secretions. Functional tonic. Surging Galvanic Powerful current for deep atro- phies. Superimposed Wave Combined galvanic and sinusoidal current of great power; has a "push and a pull" effect.	
		HIGH FREQUENCY Thermal Counter-irritant Nutritional Cellular or Ionic Massage	{	Forms	{	Oudin, high voltage (60,000 to 90,000). Low amperage	Cold spark. Great penetration but small volume. Mild heat dries. (Desiccation). Neuroses; neu- ritis. Low blood pressure.
						Tesla, medium voltage (35,000 to 45,000). medium amperage	Hot spark. Sedative and elimi- native heat for functional con- ditions. Spark burns. (Fulgura- tion.)
						D'Arsonval, low volt- age (10,000 to 12,- 000). High amper- age	True diathermic current. In- tensely applied, cooks (Coagu- lation). Powerful heat for softening and liquefying, and for organic conditions.



Large Cabinet High Frequency Giving All Modalities.

CHAPTER TWO.

The Galvanic Current.

The Galvanic or Constant Current, is the only one of the currents we consider which has a genuine chemical action. It is also the only one having definite polarity. It is this polarity which gives it its chemical power. It has a positive and a negative pole, each being the direct opposite of the other, just as much so as day and night. Whatever one pole does, the other does exactly the opposite.

As all chemical elements are either positive or negative, it will be seen that when the poles of the galvanic current are placed in a solution, all of the negative elements will be drawn toward the positive pole and all of the positive elements will go to the negative pole, thus splitting up the solution and accomplishing chemical analysis by electricity.

Electrolysis. If we take the term electro-chemical analysis and abbreviate it to electro-analysis and then cut out the letters "ana," we have electrolysis.

This action only takes place in a liquid or semi-liquid substance. The solution acted upon is known as the

electrolyte. Thus we can get an electrolytic action on the soft tissues of the body, but not on bone.

Additional Polar Effects. In our classification of galvanic currents, we noted that the positive pole was acid in reaction. When applied to the body the acid which forms is hydrochloric acid. Similarly, the alkali which forms at the negative pole is caustic soda. When certain metals compose the positive pole, minute particles of the metal are given off—such metals are said to be **polarizable metals**, copper, zinc, and mercury are examples.

Metals are not affected this way at the negative pole. A simple test is made by attaching two strips of copper to the two poles and placing one on each side of a piece of meat. Turn on a fair amount of current and let it pass for a few moments, then examine the meat. Under the positive pole, a green copper scum will be seen as a result of the polarization. No such evidence under the negative pole, although it also was of copper. Polarization takes place in the form of a nascent oxychloride of copper, zinc, or whatever polarizable metal forms the electrode.

Some metals of high atomic weight, such as gold and platinum, are called non-polarizable because apparently no portion of them is given off under the action of the positive pole.

The positive pole is germicidal in its action; the nega-

tive pole relatively speaking, is not. On the contrary, it affords a suitable alkaline culture medium for many bacteria. A theory is held by some electrotherapists that bacteria are either positive or negative in their charge and are therefore carried to the pole which is the opposite of their own charge. I cannot concur in this theory.

Polarity Tests. Since polarity is so important, it is obvious we should know simple and reliable methods of distinguishing one pole from the other. With moist litmus paper we may see that the characteristic acid reaction of changing blue litmus paper red, will indicate the positive pole; the reverse the negative.

A simple and reliable test for the negative pole is made by inserting the two poles in water and turning on 20 or 30 milliamperes of current. Bubbles gather at each pole, but as there are twice as many positive hydrogen particles as there are of negative oxygen, and as the positive hydrogen goes to the negative pole, there will be twice as many bubbles in evidence at that pole.

A simple test for the positive pole is made by watching the swing of the needle in the meter. If it swings to the right, the right hand binding post is the positive pole. If it swings to the left, the left-hand post is the positive pole. By this means whenever one is turning on the current as the meter is observed for dosage, there also may be a check-up on polarity.

I make it a rule to have a red conducting cord on the positive pole and a blue one on the negative, for convenience in rendering it unnecessary to trace out the cords to be sure of polarity. By then checking with the meter, no error is likely to occur.

Caution! When apparatus is operated on the direct current, if a plug is pulled out and the prongs reversed in re-inserting it, the polarity will be reversed. Therefore, be sure and always check your polarity by your meter. Check up your polarity by the test for the negative pole, when you first try your apparatus and note the swing of the needle which will then be definite for that machine.

Phoresis depends on the electrolytic action of the current in dissociating elements and then in attempting to carry the element desired into the tissues by combined repulsion from the like pole and attraction to the opposite pole.

The rule is to place the solution employed on or under the same pole as the polarity of the desired element, with the other pole as nearly as possible directly opposite. For example, in simple goitre, an iodide of potassium solution has been employed over the goitre from the negative pole, because iodine is negative; the positive pole being placed at the back of the neck. The theory being that the potassium, which is positive, will be held at the

negative pole, while the negative iodine will be repelled from this pole and drawn toward the positive pole opposite, thus being introduced into the tissues.

Recently it has been claimed that this process does not carry elements farther than into the skin and that all therapeutic benefit comes from absorption of the element at this point.

One thing is certain and that is that although electrons when disembodied travel at a high rate of speed, elements themselves travel very slowly and thus a long application of the current is necessary if we expect to get any phoretic action.

An easy way to remember which pole to place a solution on for cataphoresis or anaphoresis, is to bear in mind that in chemical nomenclature, with few exceptions, the positive part of the combination is given first and the negative part second; thus in potassium iodide, the potash is positive, the iodide is negative.

Take a number of chemicals and write them down as below:

Positive.	Negative
Potassium	Iodide
Cocain	Muriate
Adrenalin	Chloride
Sodium	Salicylate
Copper	Sulphate
Zinc	Sulphate





Consider what part of the solution you wish to drive into the tissues and put it on the pole corresponding to its own polarity. Thus if adrenalin or cocain are desired, the positive pole is selected; if iodine or salicylates, the negative.

Solutions for phoresis are usually weak ones; one or two percent being the rule. The higher the voltage, the greater the rapidity and depth of penetration.

Ionization and Definition of Cataphoresis and Anaphoresis. If a negative element is driven from the negative pole, the process is called **anaphoresis** and means "flowing up." If a positive element flows from the positive to the negative pole it is called **cataphoresis** and means "flowing down." Phoresis is also spoken of as **ionization**.

Surgical Electrolysis. When electrolysis is employed for the removal of growths, hair, etc., the process is the equivalent of a surgical procedure. Although electrolysis will take place with either the positive or the negative pole, it is advisable to link the thought with the use of the negative pole, which is always the one employed when the application is made to a visible portion of the body.

The reason for this is that the negative pole leaves a very slight and very pliable scar which is essentially imperceptible. If the positive pole is employed, a hard,

firm cicatrix results and also should a polarizable metal be employed, a deposit is observed in the skin.

Electrodes. In employing the galvanic current, covered electrodes are employed, except where definite action is desired from a metal electrode, as in electrolysis or metallic polarization. Otherwise if any intensity of current is used, pain and burns will result.

Remember that **an equal amount of current comes through each electrode.** If one is smaller than the other, the intensity thereby is increased and it is spoken of as the **active** electrode or pole.

A complete circuit is required for the galvanic current, that is, direct unbroken connection from one binding post to the patient and from another point on the patient back to the other binding post. Any break in the circuit stops the current. This is because of the low voltage of the current.

Covered electrodes must be soaked thoroughly in order that they become good conductors. A weak salt solution is better than plain water, the mineral being a better conductor. Also, the use of hot solutions is desirable.

Electrodes are held in close approximation to the bare skin. Sometimes the patient lies on one of the electrodes, the weight of the body making close contact. At other times electrodes are bound on, pressed firmly on

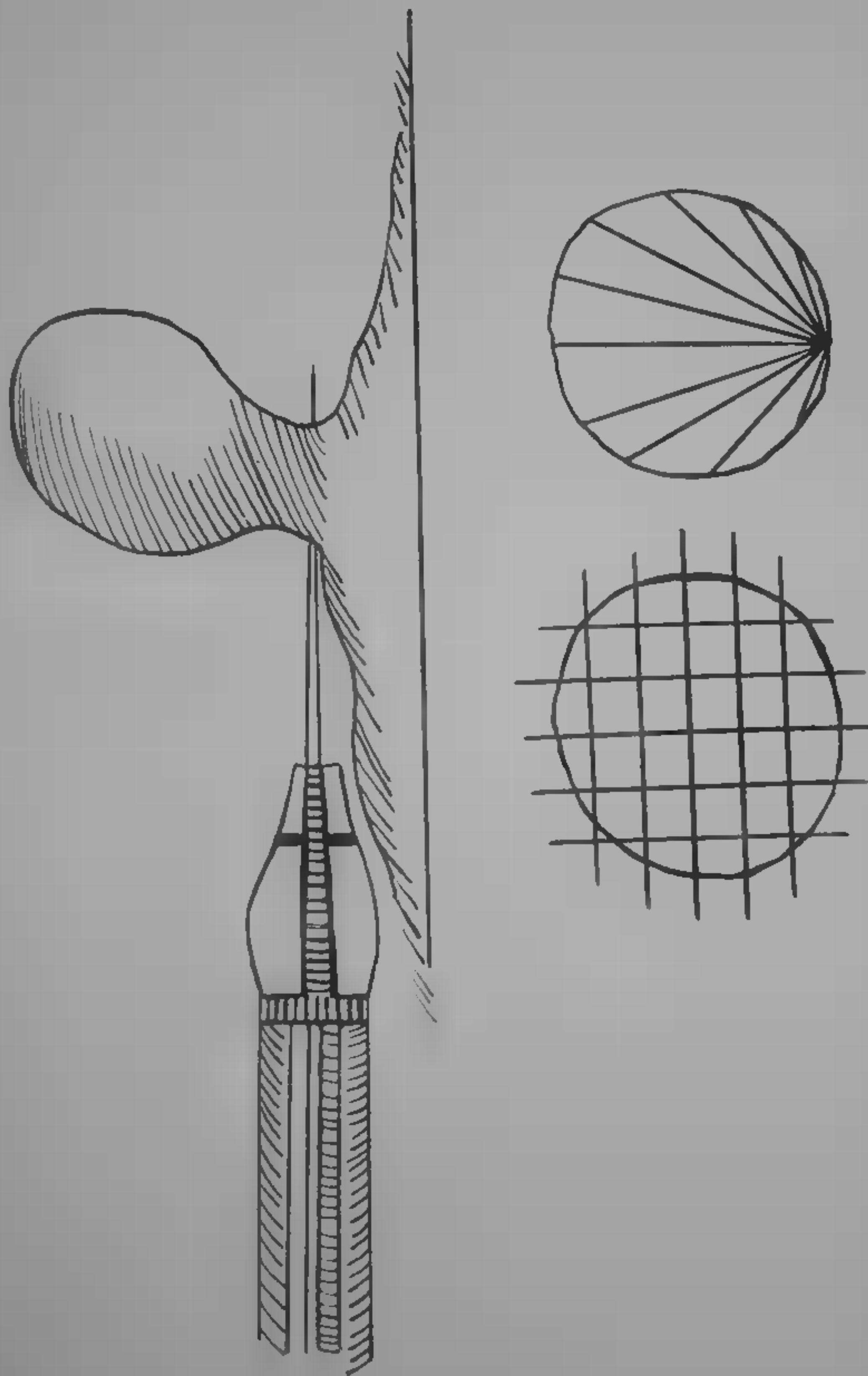


Fig. 2---Method of Inserting Needle in Various Types of Growths.

In growths having a larger base and therefore getting their blood supply over a larger area, it is necessary to introduce the needle several times, close together, and then at right angles in order to thoroughly destroy the circulation. This method is called "checker-boarding" and is diagrammatically illustrated in Fig. 2.

Years ago, in order to avoid the necessity of the repeated introduction of the needle and the frequent turning of the current on and off, I devised what I have called the "fan method," for these growths. The needle is inserted through the middle of the base, passing to the farther edge. If the point protrudes, it makes no real difference, but I stop just short of this. The current is turned on as before, for a minute or more, then the needle is drawn back, **but not out**, and then inserted a little away from the first line, thus gradually covering the base of the growth like the rays of a palm-leaf fan, as seen in Fig. 2. The current is not turned off, nor the needle removed until all of the work is done, thus saving much time and trouble. In order not to have any undue effect on the skin outside the growth where the shaft of the needle would otherwise be in contact, a little piece of sheet-rubber is inserted between needle and skin, effectually insulating it.

Antiseptic solution applied as before and patient cautioned about rubbing off the growth in washing.

There is always a little oozing at first and the formation of a crust or scab which separates in seven or eight days. If it is pulled off prematurely, a second crust forms which may result in a slight elevation being left.

After separation the skin is red at first but in a few weeks whitens out and the spot is scarcely discernible. Occasionally the growth does not separate at the usual time. Wait until ten days have elapsed and then remove. It will be found thoroughly healed.

Superfluous Hair. The principle involved in the destruction of the hair follicle is the effect of electrolysis directly on the elements composing the follicle and also its cauterization by the caustic soda liberated at the negative pole.

Presumably the physician is not going into extensive work in the removal of superfluous hair, but will employ this method more particularly for those cases where only a few hairs are to be destroyed.

Not infrequently a mole which calls for removal will have growing out of it, several coarse hairs, and to remove the mole and leave the hairs would not be much of an improvement. Consequently, the hairs are treated first.

The positive pad is placed on chest, arm, or under shoulders, as before, and the negative cord attached to the needle holder. The needle must pass down into the

hair follicle. This will be about one-sixteenth of an inch on the average, and care must be employed or the needle will pass much farther than necessary. The current is slowly turned on, employing two to five milliamperes, according to toleration of patient, and coarseness of hair. Three will be enough for most cases. The current is on for twenty to thirty seconds, then it is turned off, the needle removed and gentle traction made on the hair, with a pair of tweezers. If the needle was properly introduced and there was sufficient current, the hair will pull out readily, the dilating action of the negative pole playing its part in facilitating this. The follicle comes out whole and ■ black, cauterized spot is seen on the end. If the hair sticks, replace the needle and give another twenty or thirty seconds' treatment. This surely will be enough current and the hair may just as well be pulled out.

Many times this will reveal the fact that due to anomalies over which the operator has no control, the follicle was not in line with the hair shaft and was not penetrated nor destroyed by the current. This hair will grow again, but it will be two or three weeks before it will grow long enough to be in marked evidence.

If there is any question, use a magnifying glass and you will see a tiny ring or scar wherever the needle has been inserted. If a hair has grown out of this ring, it

is a return; otherwise it is one that never has been treated before. It is claimed that where a large amount of this work is done, even by expert operators, that thirty per cent of returns is the average, owing to the peculiarities in the growth of the hair.

Broken Veins and Acne Rosacea. Where veins are broken, leaving a small spot as we frequently see below the eye, this area may be destroyed by inserting the point of the needle and applying three to five milliamperes of current for about one minute. The spot will blanch under the action of the current. Of course, the negative pole is the active one as before.

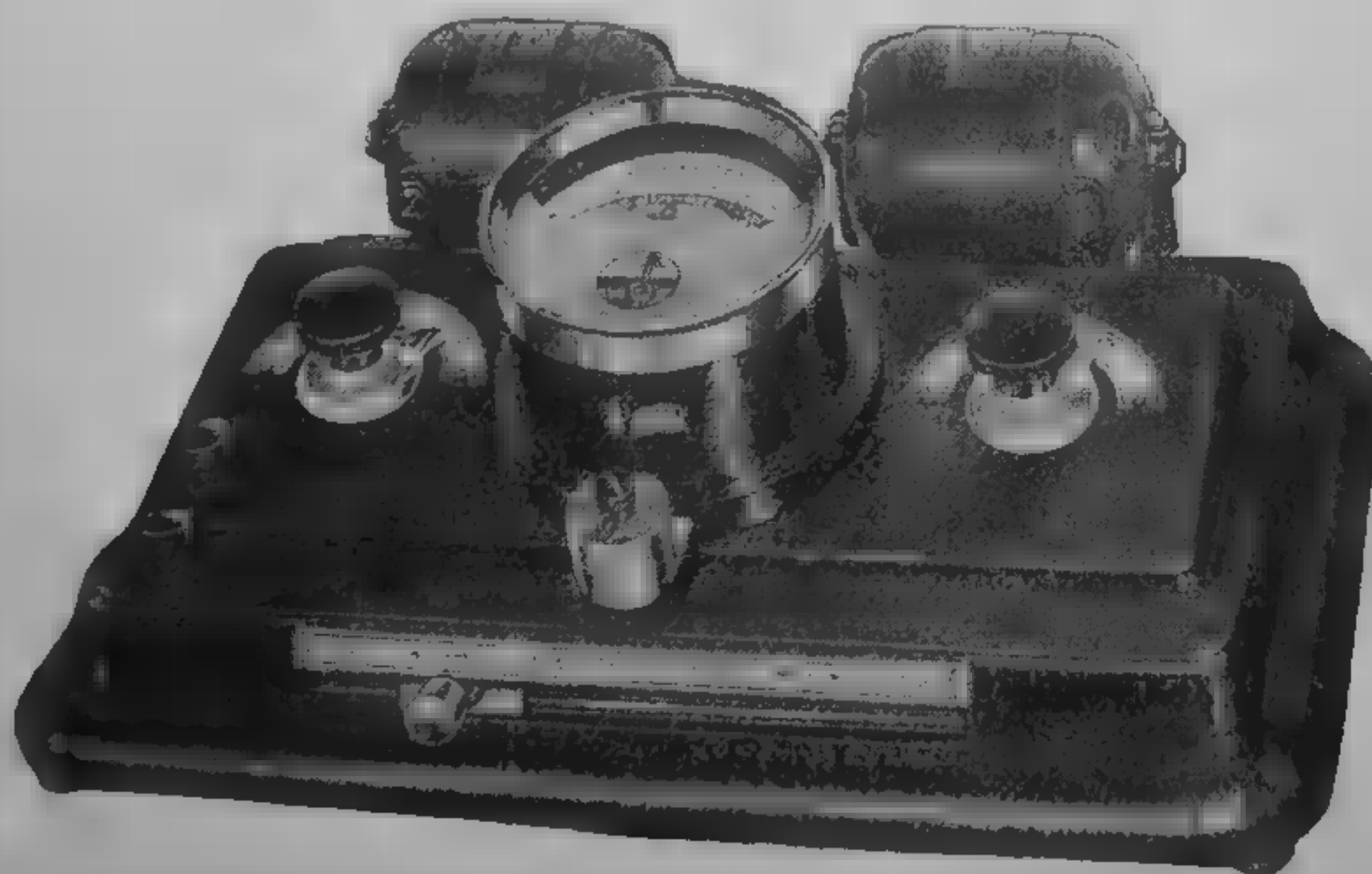
Similarly, by using a fine piece of platinum wire for the needle, it may be inserted into small varicosed veins such as are found on the nose in acne rosacea, or are frequently present on the cheeks, and these veins destroyed by negative electrolysis. The blood will be observed to rush out of the vein as the current is turned on.



Machine for All Forms of Sinusoidal and Galvanic Currents.



Multiple Wave Generator.



Galvanic Controller for True Galvanic Current.

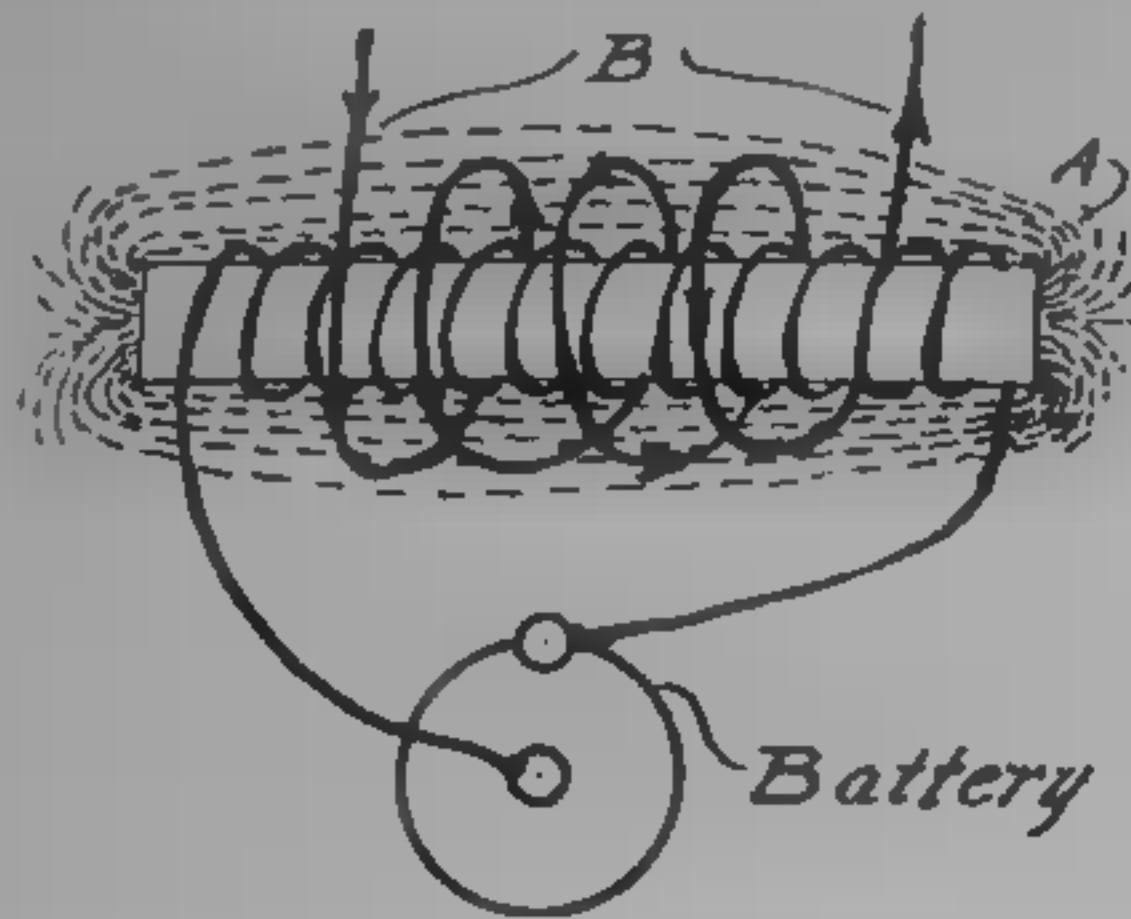
CHAPTER THREE.

The Faradic, or Induced Current.

Induction. If we wind a coil of wire around a bar of soft iron and then pass the galvanic current through the coil, we find that the iron has become a magnet, and continues so as long as the current is passing, ending abruptly when the latter stops. This is known as the electro-magnet. (See Fig. 3.)

If now another coil of wire is passed around the first coil, but not touching it at any point, it is found that whenever current is produced in the first or **primary** coil, a current is also found in the second, or **secondary** coil. It is brought there by the influence of the primary current, and is known as an **induced current**, and the process is **induction**. This is the characteristic of the faradic current.

Furthermore, if the current in the primary coil is interrupted by alternately closing and opening the circuit (called making and breaking), it is found that the induced current travels one way with the "make," and in the opposite direction with the "break."



Primary coil or electro-magnet.
Wire cutting magnetic lines (A) at right angle produces flow of electricity in wire one way (B) when current in primary is made. It then travels in opposite direction when current is broken.

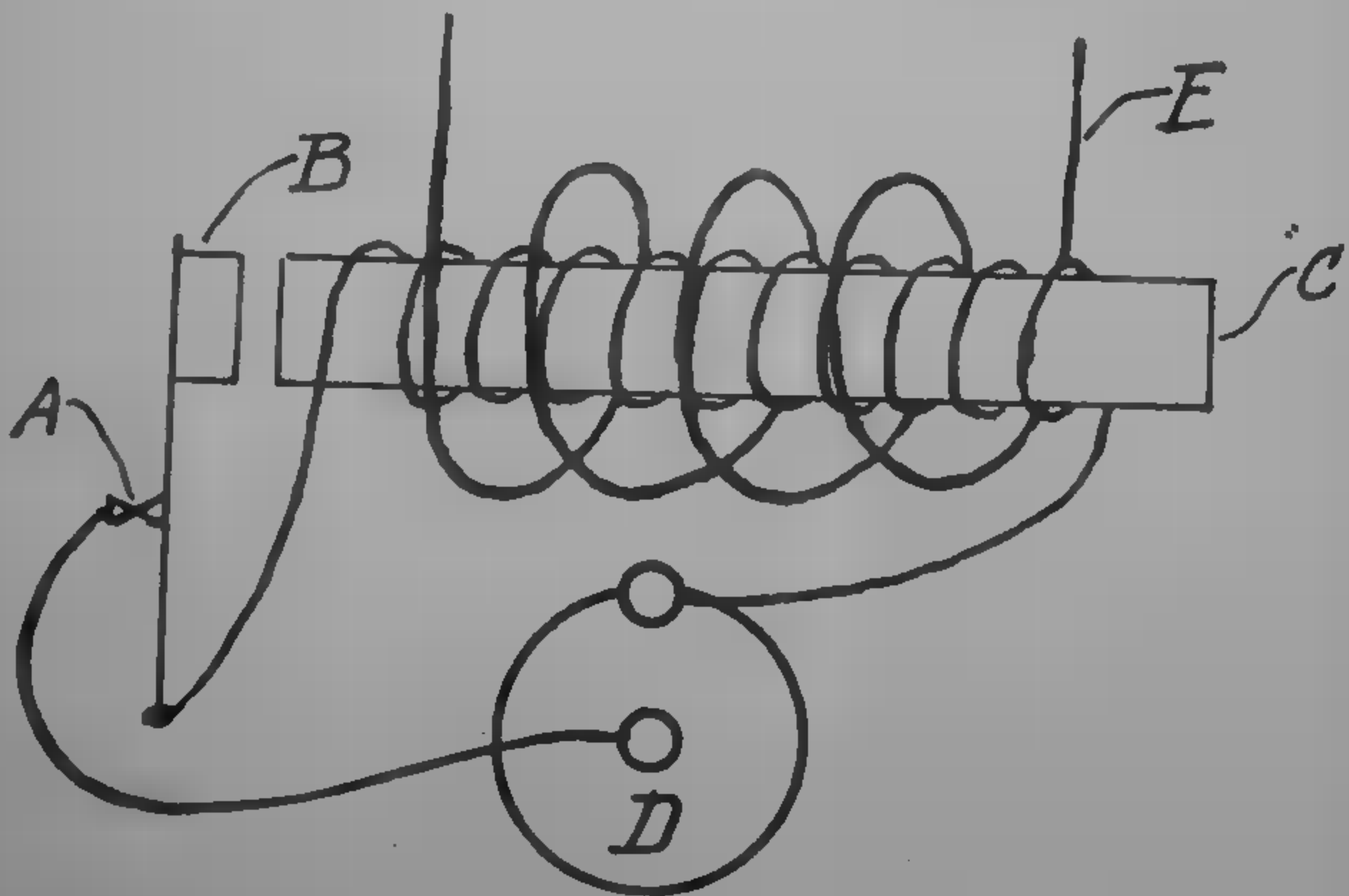


Fig. 3—Electro Magnet and Diagram of Faradic Coil.

Thus, the primary current is an interrupted galvanic current, possessing definite polarity, while the secondary or induced current, is constantly shifting back and forth and possesses no constant polarity.

It doesn't stay positive long enough to do what the positive pole does, nor negative long enough to have its effect.

What does take place when the terminals are applied to a muscle, is that a contraction takes place with each change in the direction of the current. Thus, the faradic current is a massage or exercise current. It is found that the contraction occurring with the "break," is much stronger than that produced by the "make," and thus we have an irregularity in the action of the current. In other words, **great irritation with slight stimulation**. For this reason the faradic current has been superseded to a large extent, by the sinusoidal current, which is also an exercise current, but which is smooth and symmetrical.

The reason for the sharpness of the faradic current is that the change in polarity occurs when the voltage is at the maximum. It already has been explained that a sudden change in voltage will produce definite sensation or even shock and also muscular contraction.

In the sinusoidal current the voltage rises to its maximum and then drops back to zero at the time polarity changes, thus giving no shock.



Apparatus for Galvanic and Sinusoidal Currents.

CHAPTER FOUR.

The Sinusoidal Currents.

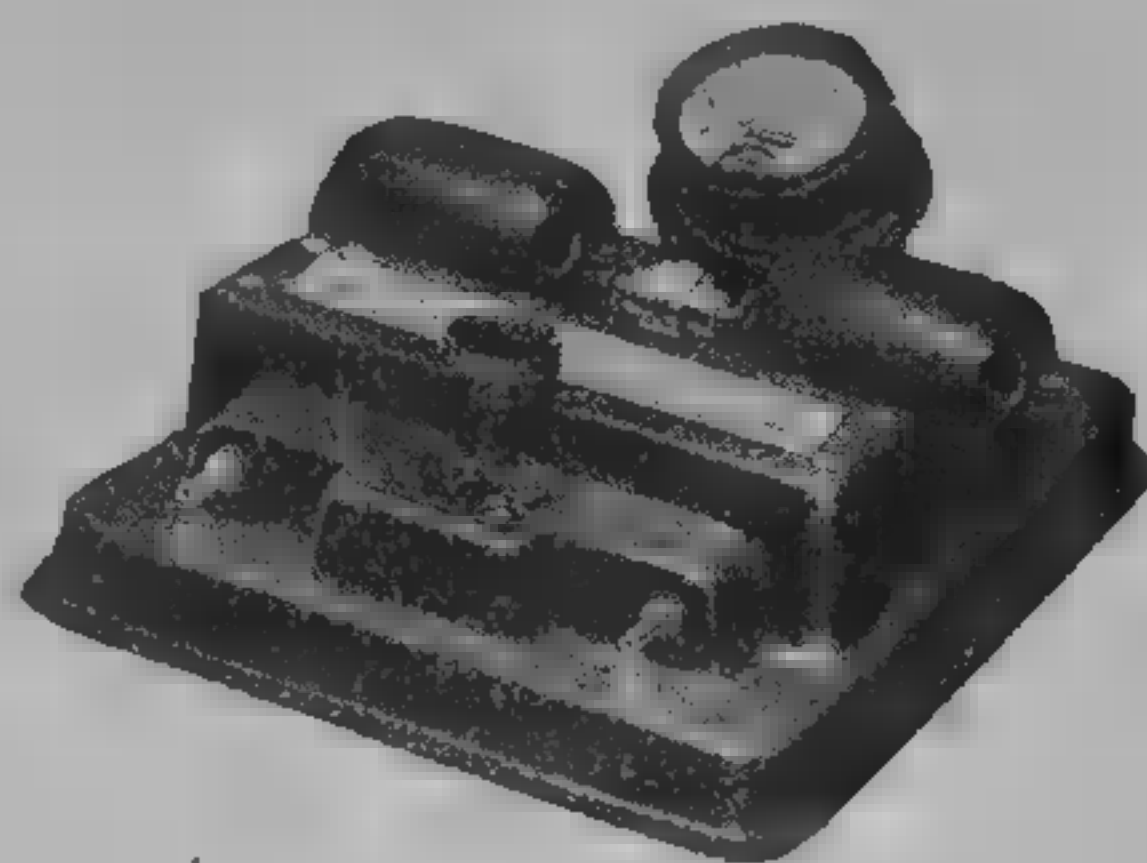
Alternating Currents. Alternating currents are low and medium frequency currents where the current is constantly changing its direction from positive to negative, making a succession of positive and negative waves.

An alternation is the complete reversal of the direction of the current; that is, either a positive or a negative wave.

The current starts at zero and goes to the maximum voltage on the positive side, reverses and back to zero and then the same on the negative side. Each wave is an alternation and ■ muscular contraction occurs with each alternation when the current is properly applied to a muscle.

Two alternations make one cycle, or the complete round of the current, one positive and one negative wave. Fix it by thinking of **circle**. The frequency of a current is the number of cycles occurring in one second of time.

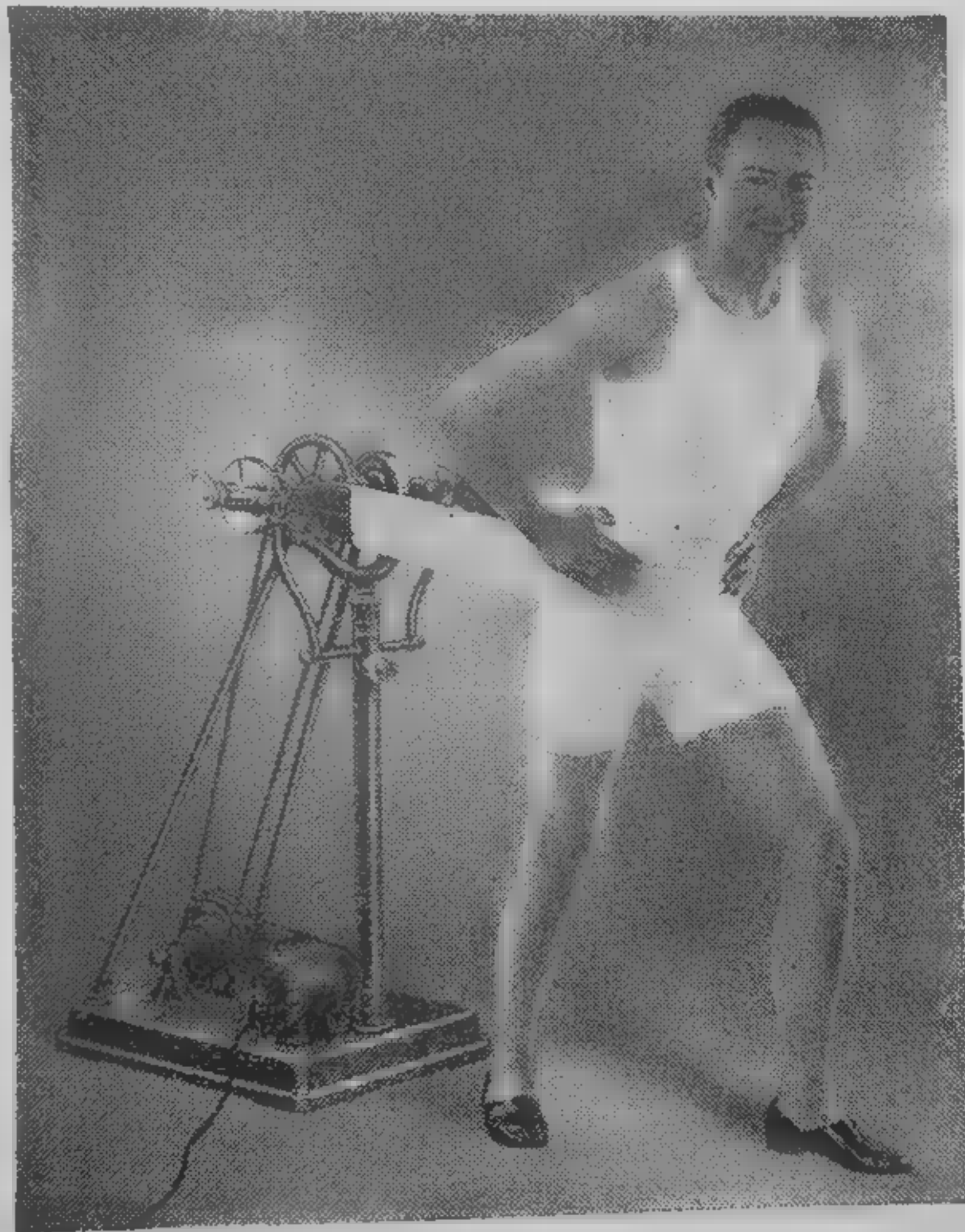
Sinusoidal currents are so called because their wave follows a sine curve. They are symmetrical in character; that is, not only does one positive wave have exactly the same form as each and every other positive wave, and the same with the negative waves, but each positive wave and



Galvanic Current Generator.



Low Voltage Generator for Galvanic and
Sinusoidal Currents.



Application of Vibration (Oscillating Type) to Abdomen.

each negative are alike so that if the wave tracing were inverted it would appear just the same.

Since a muscular contraction occurs with each wave, if they are all the same, so will the contractions be the same and thus we say that the sinusoidal current is **smooth and symmetrical**. Here it differs from the faradic current in possessing **great power of stimulation with comparatively slight irritation**.

These currents are considered in two groups, an **alternating**, and a **galvanic** group.

The alternating current group are true sinusoidal currents, while the galvanic group are galvanic currents made by a mechanical device to assume the form and do the work of the true sinusoidal currents. Besides this we have imposed one form of wave on another, making a current of different characteristics than either of its components.

I group the two types separately because it enables one to remember easily that with the alternating group either covered or plain metal electrodes may be used, while with the galvanic group only covered electrodes should be employed.

Some new and apparently effective currents have been produced by interrupting the various currents and also by means of sustaining the effect of the current at its maximum point. (Called sustained peak.)

I. ALTERNATING GROUP.

Classification.

1. **Rapid Sinusoidal**, 7000 cycles per minute. (Fig. 4.)

Note the rapid rise to the maximum voltage. This gives the whole effect of the current suddenly on the nerve. A little will stimulate, but when continued, **over-**

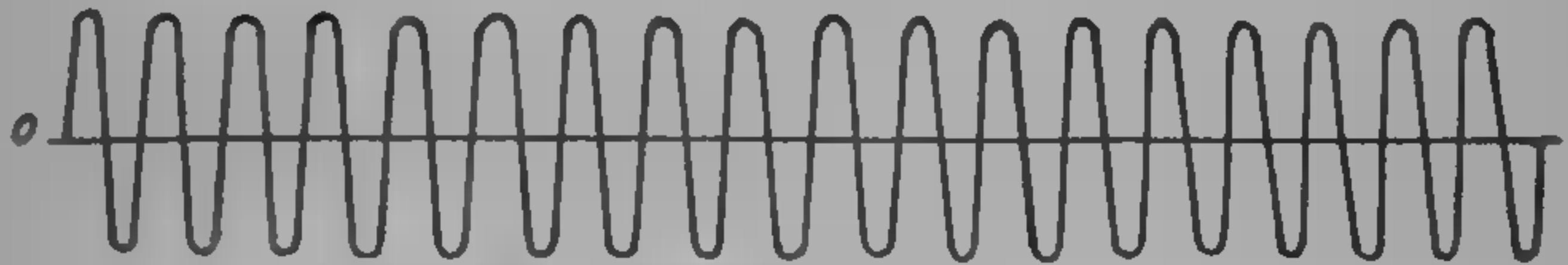


Fig. 4—The Rapid Sinusoidal Current.

stimulation which is **inhibition**, results. Therefore, we say that the rapid sinusoidal **inhibits** or **obtunds**. It relieves pain but at the expense of **fatigue**.

2. **Interrupted Rapid Sinusoidal**, 6 to 110 pulsations per minute. (Fig. 5.)

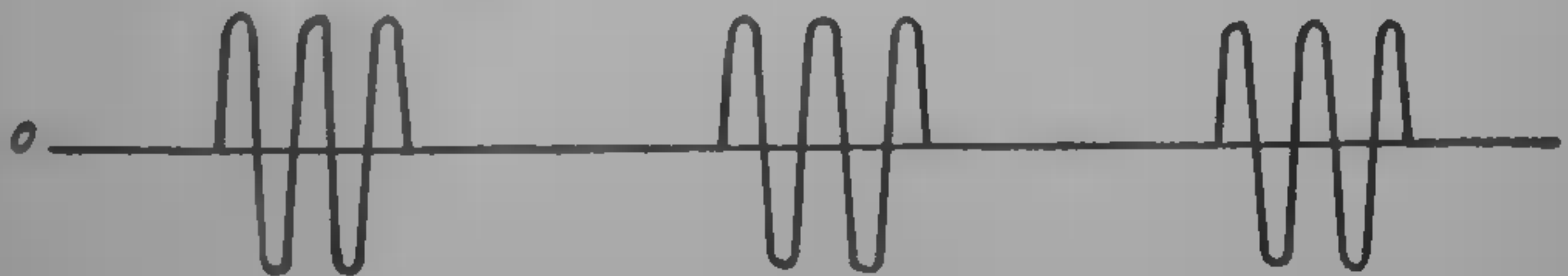


Fig. 5—The Interrupted Rapid Sinusoidal Current.

In this form by mechanically interposing ■ rest period between each double-cycle, the effect of fatigue is largely overcome, while still permitting the powerful influence

on the nerve resulting from the abrupt rise in voltage. Thus we have stimulation, or stimulation without overstimulation. In other words, it is a **true tonic** to the nerve and is the **best form of sinusoidal current we have for the regeneration of impaired nerve function**. No matter where the nerve is nor what the name of the disease, you are always on the right road if you employ the interrupted rapid sinusoidal current for impaired nerve function.

3. **Surging or Alternating Sinusoidal**, 6 to 110 pulsations per minute. (Fig. 6.)

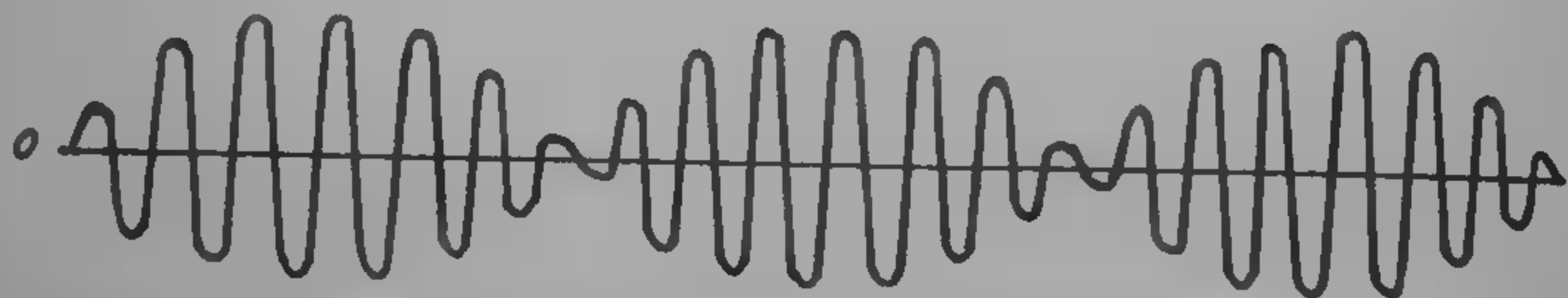


Fig. 6—The Surging or Alternating Sinusoidal.

By combining the rapid and the slow sinusoidal type waves in one, we produce a current which is of great penetration and which differs from the other forms because of the "jerk" that is apparent. This is the result of the struggle for mastery between the two wave types, the rapid and the slow, as to which shall rule. This "jerk" has been recognized as **ideal for the breaking up of adhesions and deposits**, especially when first they have been softened by the powerful heat of diathermy. Com-

pare to the process of breaking a stout string, where instead of a steady pull, one would snap it by a sudden jerk. The analogy is plain.

II. GALVANIC GROUP.

1. **Slow Galvanic Sinusoidal**, 6 to 110 pulsations per minute. (Fig. 7.)



Fig. 7—The Slow Sinusoidal.

A galvanic current made to act first on the positive and then on the negative side, by passing through the rotor. Observe the long, but comparatively shallow wave with its powerful hold on the muscle. Here is produced a current that is a powerful tonic to the muscles with its long, steady pull. At the same time through muscular contraction, the circulation is aided, infiltrates squeezed

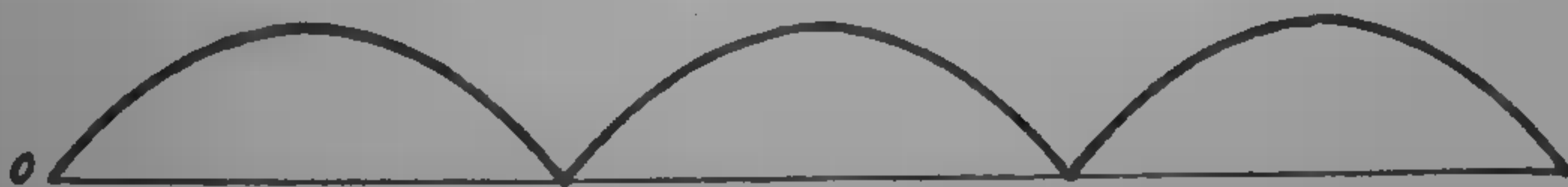


Fig. 8—The Surging Galvanic or Unidirectional Galvanic Wave.

out, and secretions increased. This is the current of choice, as **a tonic to muscles and secretions.**

2. **Surging Galvanic or Unidirectional Galvanic Wave**, 3 to 55 pulsations per minute. (Fig. 8.)

This is not a sinusoidal current, but is classified here because its wave is similar in character to that of the slow sinusoidal, but it is only on one side of the line, consequently it possesses definite polarity. Thus polar or chemical effects may be combined with the property of tonic muscular contraction. In certain profound atrophies this is found more serviceable than the slow sinusoidal.

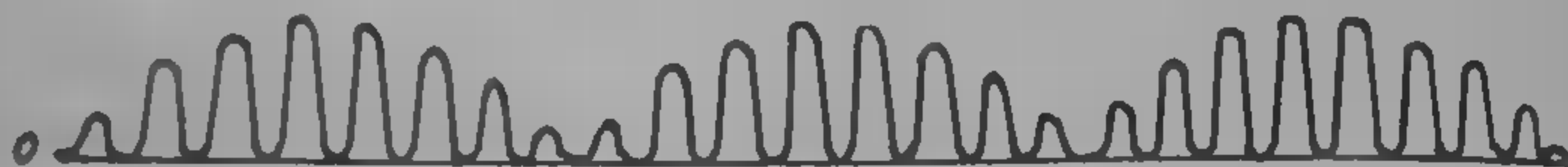


Fig. 9—The Superimposed Wave.

3. The Super-imposed Wave. (Fig. 9.)

This current is a combination of a galvanic and a sinusoidal current, coming in opposite directions. It has the effect of a "push and a pull" and is felt first on one side and then on the other. A tonic-stimulant current valuable in ptosis and intestinal stasis. A favorite current for treatment of "flat-feet."

III. THE NEW CURRENTS.



Fig. 9a—Slow Sinusoidal, Interrupted.

1. **The Slow Sinusoidal, Interrupted** (Fig. 9a). This is the slow sinusoidal with a pause between the waves en-

abling a longer use of it without fatigue. 6 to 110 pulsations per minute.

2. **Slow Galvanic Sinusoidal, Sustained Peak** (Fig. 9b). In this form the current stays on at its maximum getting



Fig. 9b—Slow Galvanic Sinusoidal, Sustained Peak.

a more powerful influence in muscular contraction. The currents having the sustained peak, are destined to be extremely popular in treating severe cases of intestinal stasis.



Fig. 9c—Alternating Sinusoidal, Interrupted.

3. **The Alternating Sinusoidal, Interrupted** (Fig. 9c) allows of longer and more effective use of this valuable form of sine current.



Fig. 9d—Alternating Sinusoidal, Sustained Peak.

4. **The Alternating Sinusoidal, Sustained Peak** (Fig. 9d) holds the effect of this deep and powerful massage current at its maximum point of efficiency. Used in intestinal stasis.

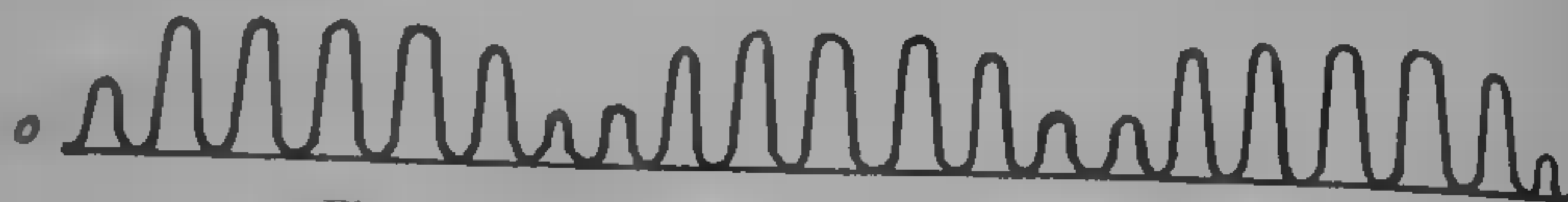


Fig. 9e—Superimposed Wave, Sustained Peak.

5. **Superimposed Wave, Sustained Peak** (Fig. 9e). Of all the sine currents the superimposed wave has shown the greatest value in profound cases of intestinal stasis resisting the action of the other sinusoidal currents, and also in treating impotency. By holding the current at peak voltage its efficiency is enhanced to a still higher degree.

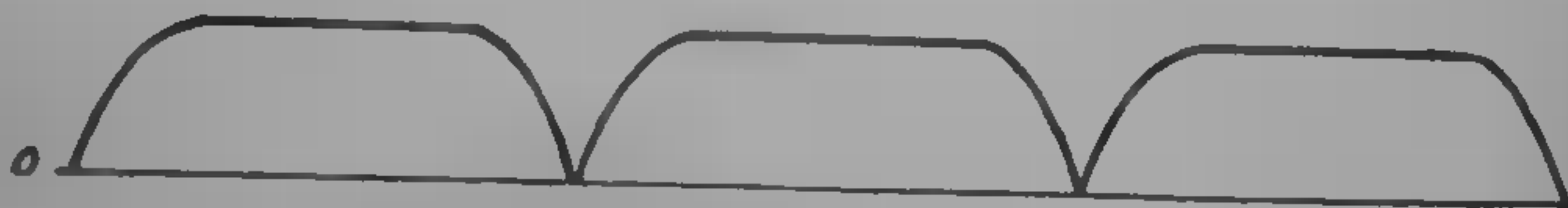


Fig. 9f—Galvanic Wave, Sustained Peak.

6. **The Galvanic Wave, Sustained Peak** (Fig. 9f) is the surging galvanic wave with its action sustained.

IV. INTERRUPTED GALVANIC.

This form of galvanic current (Fig. 9g) is included in this chapter because it is used as an exercise current.

Because of the perpendicular rise and fall in the current with the making and breaking of the current there is produced the most powerful electrical stimulus that we have. I call it "the last word" in muscle stimulation. That is why it is our "stand-by" in the various paralyses.



Fig. 9g—Interrupted Galvanic.

In General. If the sinusoidal currents are applied in accordance with my suggestions above, a higher percentage of successful results will be obtained than if they are used in a haphazard way.

Sinusoidal currents are employed in chronic, not in acute conditions. (One would not exercise an actively inflamed part.) There are some exceptions where fine muscle fibers are involved.

The dosage is always in accordance with the patient's toleration.

The use of these currents through the heart area is contra-indicated ordinarily and fatal results have been reported. There is more danger from alternating than from direct or high frequency currents, owing to the powerful concentration of ions which they produce.

The average application is from three to five minutes. Occasionally up to ten or fifteen minutes is employed.

Remember that any exercise current if continued long enough finally will produce over-stimulation or inhibition through fatigue. This is the reason for the comparatively short time of applying these currents.

A slow type of current or one producing relatively few contractions naturally may be used longer than one producing rapid contractions, but always bear in mind the danger of over-exercise which may defeat the result you are trying to obtain.

CHAPTER FIVE.

High Frequency Currents.

Definition. A high frequency current is an oscillating current of 10,000 or more cycles per second.

General Considerations. High frequency currents occur in three forms, Oudin, Tesla and d'Arsonval, which differ from one another physically in but one respect, the proportion of voltage and amperage. This, however, makes a decided difference when we consider them from the standpoint of their physiological action.

In any high frequency apparatus of whatsoever make, there are certain fundamental elements: transformers to raise or lower voltage; spark-gaps to introduce resistance and produce a definite condenser charge; condensers to regulate frequency; and the necessary connecting wires, switches, etc. No more current can be taken out of one of these machines than is put into it, but the relative proportion of voltage and amperage can be regulated as desired and also the frequency.

The efficiency of any machine is represented by the wattage produced; that is, a product resulting from multiplying voltage by amperage.

As voltage is transformed upward, amperage goes down lower, and vice versa. **This is an inflexible rule.**

In the three forms of high frequency, the Oudin current is one of very high voltage, averaging from 60,000 to 90,000 volts, while the amperage is very slight. In the Tesla current there is medium voltage (35,000 to 45,000 volts), and also medium amperage. In the d'Arsonval current the voltage is low (10,000 to 12,000 volts), which allows the amperage to be at the highest possible point.

An easy way to comprehend the difference in these currents is to think of an old-fashioned "see-saw." Fig. 10. The board in the "see-saw" can occupy only three general positions. One end can be high in the air, when the other must be near the ground; or the conditions may be reversed and the end that was in the air brought down to the ground, when as a necessary result the previously low end goes up in the air. Finally both ends may be balanced at a relatively even height above the ground.

If we place voltage on one end of the board and amperage on the other, the three positions will exactly correspond to the three forms of high frequency current.

When the voltage end is high in the air, the amperage end is down low, and this is the case in the Oudin current.

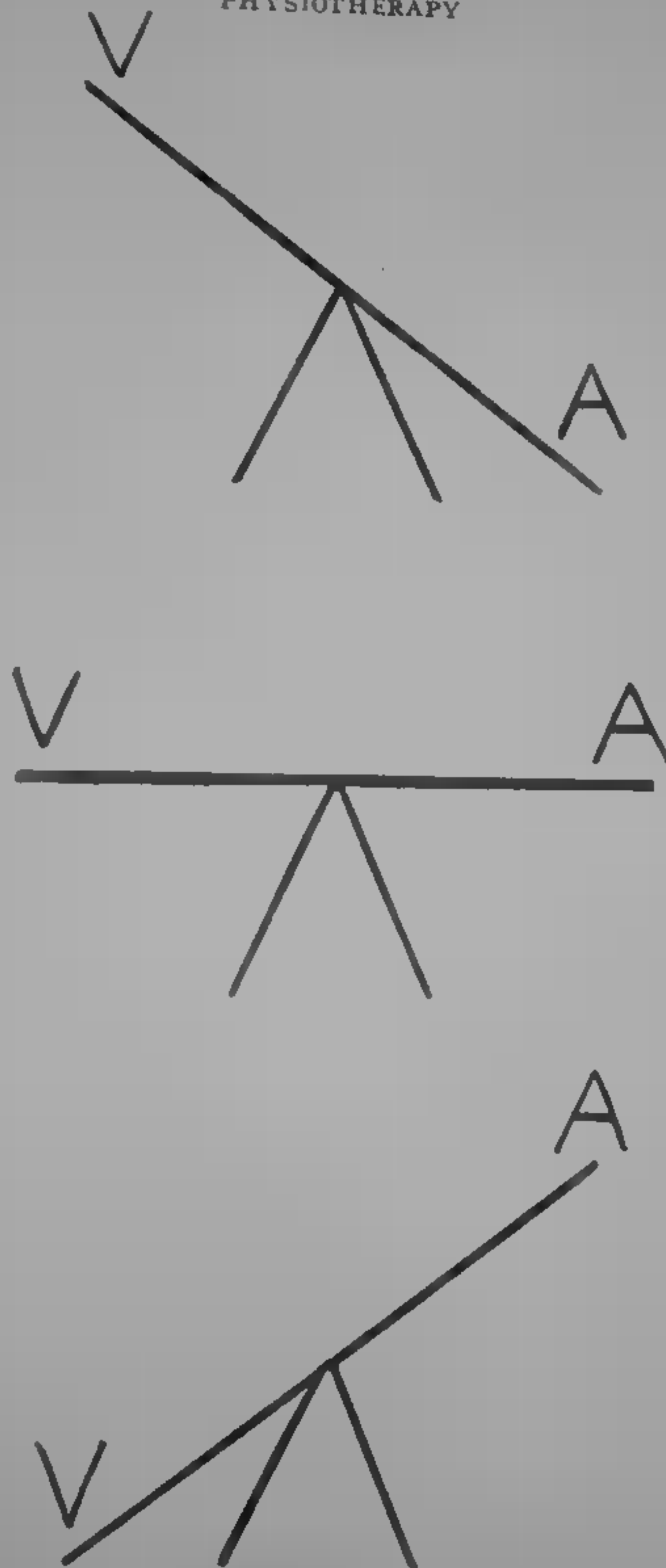


Fig. 10—Showing the Variations in Voltage and Amperage in the High Frequency Currents by Comparison with the Positions of a "see-saw".

When both ends are practically even, then the condition is similar to the adjustment of voltage and amperage in the Tesla current.

When the voltage end is down low, the amperage end is high in the air, and this is the condition in the d'Arsonval current.

Note that both ends of the board cannot be high in the air at the same time, neither can we have both voltage and amperage high after the current is transformed. **When one goes up the other must come down.**

Significance of Voltage and Amperage. Voltage means penetration and amperage means heat. By keeping these points in mind it will help in selecting the form of high frequency current you wish to employ.

For instance, the sheath of the nerve is one of the most resistant parts of the body to the passage of electricity. Although ordinarily the voltage of the Tesla current gives sufficient penetration for this purpose, in any case where doubt exists, you know that the Oudin current will penetrate because of its higher voltage; but the volume of current will be smaller. If you care to test how far away a vacuum electrode will be influenced (illuminated) by the current, you will note that the greatest distance is from the Oudin, next the Tesla and finally the least distance is from the d'Arsonval. In other words, in direct proportion to the voltage.

On the other hand, when heat is desired it goes with the amount of amperage and is therefore greatest in the d'Arsonval current, the Tesla second and the Oudin least of all.

The first high frequency current produced was the d'Arsonval, then the Tesla and finally the Oudin, the names being those of the men who discovered the different forms. It is interesting to note that d'Arsonval in his experiments which led to the production of the high frequency current, produced the first sinusoidal current as what might be termed a "by-product."

Germicidal Action. All high frequency sparks are directly, positively and absolutely germicidal. This has been demonstrated by destroying cultures of all of the better known germs. It is easy to verify this statement, and it indicates the reason for employing the spark in many conditions where this germicidal action is desired. Because of its greater amperage, the Tesla spark is more powerful in its action than that obtained from the Oudin circuit.

✓ **The Oudin Current.** Because of the slight amperage or heat of this current the spark has been known as the "cold" spark. It is not as cold as the name implies, and you will find no difficulty in lighting a gas jet with it, but in comparison with the Tesla spark it is relatively cold.

A simple test is to take a condenser electrode and



Cabinet High Frequency.



Cabinet Type High Frequency.

attach it to the Oudin terminal. Turn on enough current to give a fair spark from the electrode. Now leave the machine set as it is, but attach the electrode to one pole of the Tesla, change the selector switch and throw on the current. See how much hotter the resultant spark is. There is exactly the same amount of current coming through the electrode as before, but it has been transformed so that its voltage is lower which has permitted its amperage or heat to rise to a higher degree.

The high voltage of the Oudin current gives it the advantage in treating neuritis and neuroses.

When applied with a metal point its heat dries or dehydrates the tissues. This is called **desiccation**. Because of its small volume it is always a uniterminal current.

The Tesla Current. The greater amperage or heat of this current causes an increased action on the part of the secretions and influences general elimination. This is particularly true of the purin bodies (urea, uric acid, creatin and creatinin), and its action may be checked up easily by an examination of the urine before and after a half hour of Tesla auto-condensation.

It is indicated in the form of auto-condensation wherever increased elimination is desired. In all toxic conditions it is the method of choice. Its heat is not sufficient to cause organic changes. It is employed in **functional conditions**.

Tesla auto-condensation is one of our most reliable methods for aiding in the absorption of exudates, wherever located. Think of it for aiding in the absorption of blood-clot in apoplexy; in hemorrhages into the posterior chamber of the eye; in chest exudates, etc.

Locally it exerts a greater influence on swelling than any of the other currents. Applied by the indirect method, both by means of the spark and the localization of heat, it will take out the swelling from a sprained wrist or ankle to a definite and noticeable degree during a ten or fifteen-minute application. It will do the same for a bruise or a "black-eye."

Directly applied it shows its great power of shrinking tissues as in cases of rhinitis; soft, boggy tonsils, etc.

When used with a metal point, its heat is greater than the Oudin current and it burns rather than dries. and this is called **fulguration**. It is used either as a uni terminal or bi-terminal current.

✓ **The d'Arsonval Current.** This is our great heat current. Having a lower voltage than either of the other currents, the amperage is correspondingly higher, in short, the highest that has ever been applied to the human body. This is the **true diathermic current** because in diathermy we are after heat and this furnishes the greatest amount possible.

Because of its great heat it has the effect of soften-

ing fibrosis and deposits; of influencing sclerotic conditions, in short, its **powerful heat** is capable of accomplishing **organic changes** which were not possible with the two other currents.

At the same time, this heat will liberate toxins in the system faster than the current's eliminative powers can take care of, consequently in the general application (auto-condensation) it should not be used until elimination is well established or it will definitely increase the toxicity of the patient as will be evidenced by dizziness, which is well known as the first and most definite symptom of intoxication.

On the other hand, in arterio-sclerosis this is the only current that will have any real influence on the sclerosis itself, but it should follow Tesla auto-condensation and not be the initial form employed.

Locally applied it exerts its softening effect (for heat is a great solvent), on fibrosis and on deposits, thus preparing them for the action of other currents, such as the surging sinusoidal. It has a liquefying action on sputum, pus, etc., and dilates and distends blood-vessels.

When localized over a small area, its heat is too much for the resistance of the tissues, and "cooking" takes place which we call **coagulation**.

All of this will be referred to again under the heading of Diathermy. The d'Arsonval current is always bi-

terminal. It will be noted that the Oudin current is uni-terminal only, the d'Arsonval bi-terminal only. The Tesla, coming between the two and their extremes of voltage and amperage, partakes of the characteristics of its neighbor on either side and may be employed as either a uni-terminal or a bi-terminal current. For years we have used the terms unipolar and bi-polar for the high frequency current; but this is, of course, incorrect as this current possesses no definite polarity, but is constantly oscillating back and forth.



Variofrequency Diathermy Outfit.

Synopsis of Technique. All of the methods in vogue at the present time for employing high frequency currents, are summarized in the accompanying table, and later individually discussed.

Synopsis of Technique.

QUIPPIN

High voltage and low amperage

Uniterminal

Applied with vacuum or non-vacuum electrodes to surface or cavities of body. If a small metal point or disk is used the intensified action dries or dehydrates, and is called *desiccation*.

Direct

Application with vacuum or non-vacuum electrodes.

If metal point is used the greater amperage causes the current to burn, which is *fulguration*.

Indirect

Patient connected to one terminal by sitting or lying on auto-condensation pad; or by holding large metal handle. This produces a condenser charge in the patient which is grounded through the operator, by contact with fingers or an electrode, producing either sparks or localized heat as desired.

TESLA

Medium voltage
and medium am-
perage

Uniterminal

Bi-terminal

Auto-condensation. Patient on pad connected to one terminal, holding a metal handle connected to the other terminal. Block tin electrode over bare abdomen may take place of handle. It is possible usually to draw indirect sparks from patient during auto-condensation. Two metal electrodes may be used for *Tesla Diathermy*.

d'ARSONVAL (Diathermy)

Low voltage and high amperage

Bi-terminal

Use of two metal electrodes to cause heat conversion where desired in body. This is *Medical Diathermy*.

If one electrode is a metal point or disk, *coagulation* results, which is *Surgical Diathermy*.

Auto-condensation in same manner as with Tesla current. This is *General Diathermy*.



Uniterminal Technique with Oudin or Tesla Current.

At the present time the uniterminal method with the glass vacuum or non-vacuum electrode is limited practically to its use for surface conditions, such as skin diseases, and to some extent in neuritis, etc. Formerly this type of electrode was used also in the cavities of the body, but this has fallen into disuse lately for two reasons: first the danger of the electrode breaking within a body cavity, and second because diathermic methods with metal electrodes not only overcome the first objection, but also afford so much more heat that results are more prompt and effective.

In using a glass electrode over the surface of the body it is passed back and forth in light contact with the skin, thus giving ■ mild spark or effleuve readily tolerated by the patient. If the electrode sticks on the skin, dust on a little talcum powder or lay on a layer of gauze over which the electrode slides smoothly.

In the case of itching surfaces the electrode is raised part of the time to give the sharp effect of the spark which is very grateful to the patient and gives at least temporary relief to the itching. A definite length spark may be secured by laying on two or three thicknesses of gauze, the spark passing through without difficulty.

There is no accurate rule for dosage. The amount of amperage or heat is too small to be recorded readily by

a hot-wire meter. In the early years of the high frequency current, being confronted with this difficulty, I originated the very crude method of estimating the current from the length of spark which could be drawn from the electrode.

You will observe that the spark will jump a certain distance from the glass, say a quarter of an inch, and that with the same amount of current passing it will be impossible to secure a longer spark.

This can be done only by increasing the amount of current coming to the electrode. Taking advantage of this fact I established the rule of gauging the strength of current by the length of spark that could be drawn.

When directions say "Use a sufficient amount of current to produce a quarter or half-inch spark," it does not mean that the electrode is held away from the surface so that the full-length spark will pass. On the contrary, unless expressly stated otherwise, the electrode is kept in light contact with the skin, thus affording plenty of current, but not producing a spark of sufficient length to be painful.

This method of dosage is faulty because it does not take into consideration the thickness of the spark nor the amperage of the current. Thus, with the cold type spark of the Oudin current, a half-inch spark could be applied with its full sparking length and not be very sharp.

When switching over to the Tesla with the same initial current, the greater amperage of the latter would often make the same length spark too sharp for comfortable application.

Despite these objections, no one seems to have devised a better method; and so my rule for dosage has been generally adopted.

Desiccation and Fulguration. When a metal point is substituted for the glass electrode, the current is so increased in density that the intensive action of the amperage or heat is produced, being the dehydrating or drying effect known as **desiccation** when the Oudin current is employed and the burning effect called **fulguration** when the Tesla current is used. This becomes really the **surgical** use of the unipolar currents and is employed in the destruction of small growths of all kinds. **Desiccation** is preferable for the smaller and softer growths because it is comparatively painless. (Fig. 11.) It is also better for growths on mucous membranes. There is, however, comparatively slight penetration to its heat effect and so for a deeper effect and in larger growths, **fulguration** is preferred.

In using either method test the spark it will produce by holding the point of your electrode close to a piece of metal. One of the knobs on your machine will answer. Thus you can regulate the size and intensity of your



Fig. 11—Desiccation of Mole on Cheek.

spark to a degree that seems suitable for the case. First apply interrupted sparks around the margin of the growth and then to the center. Be sure that you get in the entire margin so that all of the growth will come away. The point of the electrode may be, if preferred, in direct contact with the growth or even inserted, but the use of a short spark is more frequent. A local anæsthetic may be employed if desired. The penetration of the process may be estimated by pressure over the treated growth with the finger. The part acted on has a hard feeling and a little experience will enable one to judge whether this seems to be thick enough to reach to the base of the growth.

A growth treated by either desiccation or fulguration will separate and come away ordinarily in seven or eight days, leaving a red surface, but no scar. After some weeks it will become white and scarcely discernible. When the part treated comes away, if some of the growth remains, it is treated again.

I have successfully removed by fulguration, growths as large as two inches in diameter and nearly one inch thick. This calls usually for several applications.

Some prefer to trim away the growth as soon as it has been treated, applying a few sparks to the base if there is any bleeding. I usually follow the method of letting Nature do the enucleation.



Desiccation.



Cabinet Model Diathermy Machine, Resogap Control, with View Under Hood and of Switch-board.

The pain is due to the accumulation of heat in the tissues and if this be rapidly conducted away the pain will be lessened perceptibly. Tousey first suggested holding the growth with a pair of tissue forceps and thus carrying off the heat and decreasing the pain. I have found that holding the area between two thimbles, (one on thumb and one on second finger), accomplishes the same purpose in areas where it is hard to use the tissue forceps.

Indirect Tesla Technique. On account of its great flexibility and adaptability, this is one of the most satisfactory methods of employing the high frequency current.

The patient is placed on the folding auto-condensation pad, either sitting or lying, as preferred, and the pad is connected to one terminal of the Tesla current. The result is the inducing of a condenser charge in the patient's body. If left this way a form of auto-condensation really is being given. It might be called **unipolar auto-condensation**.

If the operator brings his fingers close to the patient, the charge in the latter's body will jump across the small air-gap and ground itself through the operator's body. The operator acts like a lightning rod to carry off the charge.

If the operator's hand is applied quickly to the pa-

tient's skin and held firmly, the same grounding of the charge takes place, but is not felt because there is no opportunity for a spark to pass.

If, now, the contact with the patient be reduced to that of one or two fingers; since all of the charge passes off through this small area, the intensity will be so great that marked heat will be felt under the operator's fingers.

If this heat becomes so intense that it seems about to burn, make contact with additional fingers or with the other hand, and by thus spreading out or increasing the area through which the charge escapes, the intensity and heat are immediately lessened.

Thus it may be seen that we can with the use of one hand as a rheostat, govern the amount and character of the charge escaping through the smaller area, so that we may draw a sharp spark or a fine spark, or have mild or intense heat at will.

The charge may be drawn off through a vacuum or non-vacuum electrode held in the operator's hand, also controlling the amount, if desired, by the other hand.

In a similar manner a metal point may be held and a spark drawn by it for use in fulguration. This is called **indirect fulguration**. (Fig. 12).

The advantage of the indirect Tesla method is that you may have, at will, a fine or a heavy spark, mild or intense local heat, all instantaneously without the neces-



Fig. 12—Indirect Fulguration of Small Growth on Wrist.

sity of regulating the output from the machine after it is once adjusted; merely using one hand as a rheostat.

The indirect spark may be used in any condition where the direct spark would be employed.

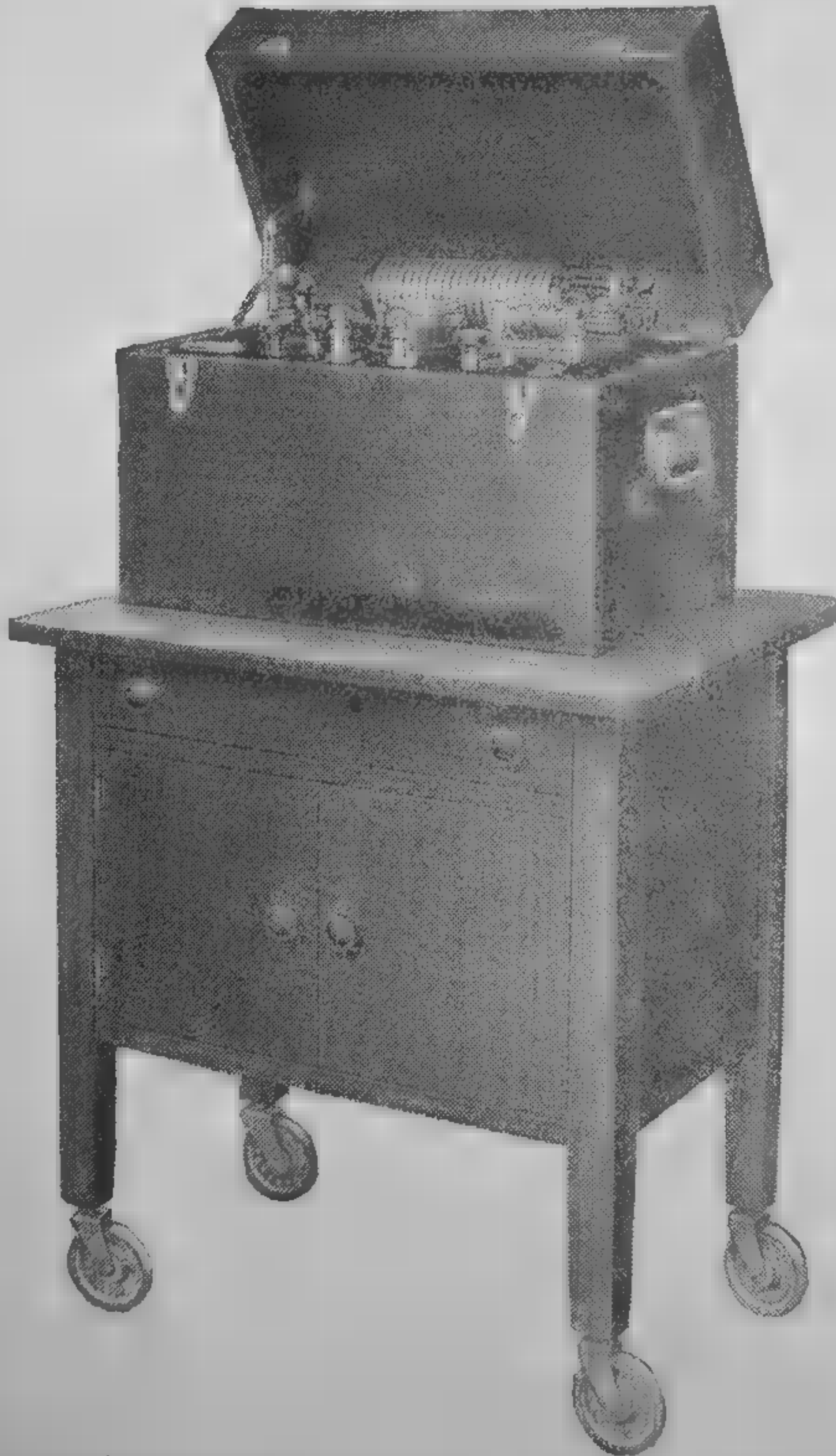
The localization of heat by this method is particularly valuable where small areas are involved as in frontal sinusitis; acute tonsillitis or laryngitis, etc. A combination of mild spark and heat localization is very efficient in all conditions where cellulitis is present or where there is extravasation of blood in a bruise; thus it is signally useful in sprains and contusions. Also in skin diseases, neuritis, etc.

The terminal to which the pad is attached is always the large knob from the secondary Tesla coil.

If the patient is connected to the single Tesla terminal by holding a large metal handle, the indirect method is also possible, but I do not consider it as effective.

In some apparatus the unipolar Tesla is called the Oudin current. The true Oudin current calls for a resonator coil, and because of its very high voltage, it must be placed on the outside of the cabinet or else its voltage will have to be reduced below 60,000 volts.

Auto-condensation. In auto-condensation the patient is placed on the auto-condensation pad, chair or couch and the latter connected to one terminal of either the Tesla or d'Arsonval current. Then the patient is con-



Convenient Portable Diathermy Apparatus.



Diathermy Outfit.

nected directly to the other terminal. In other words, the patient's body takes the place of one metal layer in a condenser and thus the auto or self receives the condenser charge. As the polarity is rapidly oscillating back and forth so the charge in the patient's body is constantly changing from positive to negative and this establishes the phenomenon of "cellular massage" with its consequent effect on nutrition and metabolism. This is greatly enhanced by the action of the considerable amount of heat which is produced in the patient's body and which may be shown by the use of a clinical thermometer.

For years we have been making the direct connection to the patient by means of a metal handle held in the latter's hands. The meter measuring the current is placed usually in that part of the circuit leading to the patient. It is a hot-wire meter and really measures the amount of heat produced by the current through its effect in causing expansion in a silver wire. Although most meters are carefully standardized, tests of different manufacturer's meters on the same circuit, often reveal considerable variation.

When the patient is holding the metal handle it is necessary to place a pillow or cushion under the handle to avoid the possibility of a short circuit through to the body, through contact with a corset steel, keys, chains,



Fig. 13—D'Arsonval Auto-Condensation (General Diathermy).
This method, with patient holding handle not generally used at present. See text.

or any metal about the patient. (Fig. 13.) Metal threads in the embroidery on a woman's dress will cause annoying sparks as will sometimes the presence of metal hair pins.

The latest technique consists in employing a large (say 5x7 inch) block tin electrode directly over and in contact with the skin of the abdomen.

The reasons for this are first because with the handle the current passing in will be felt as heat most strongly in the narrowest area, which will be the wrists. This is obviated by the block tin abdominal electrode and at the same time the viscera receive promptly the effect of the current which is where it is particularly desired. This method necessitates disrobing but is advised, especially so when d'Arsonval auto-condensation is used or where a long treatment is given.

In the treatment of high blood pressure it is important that this block tin electrode is placed over the liver.

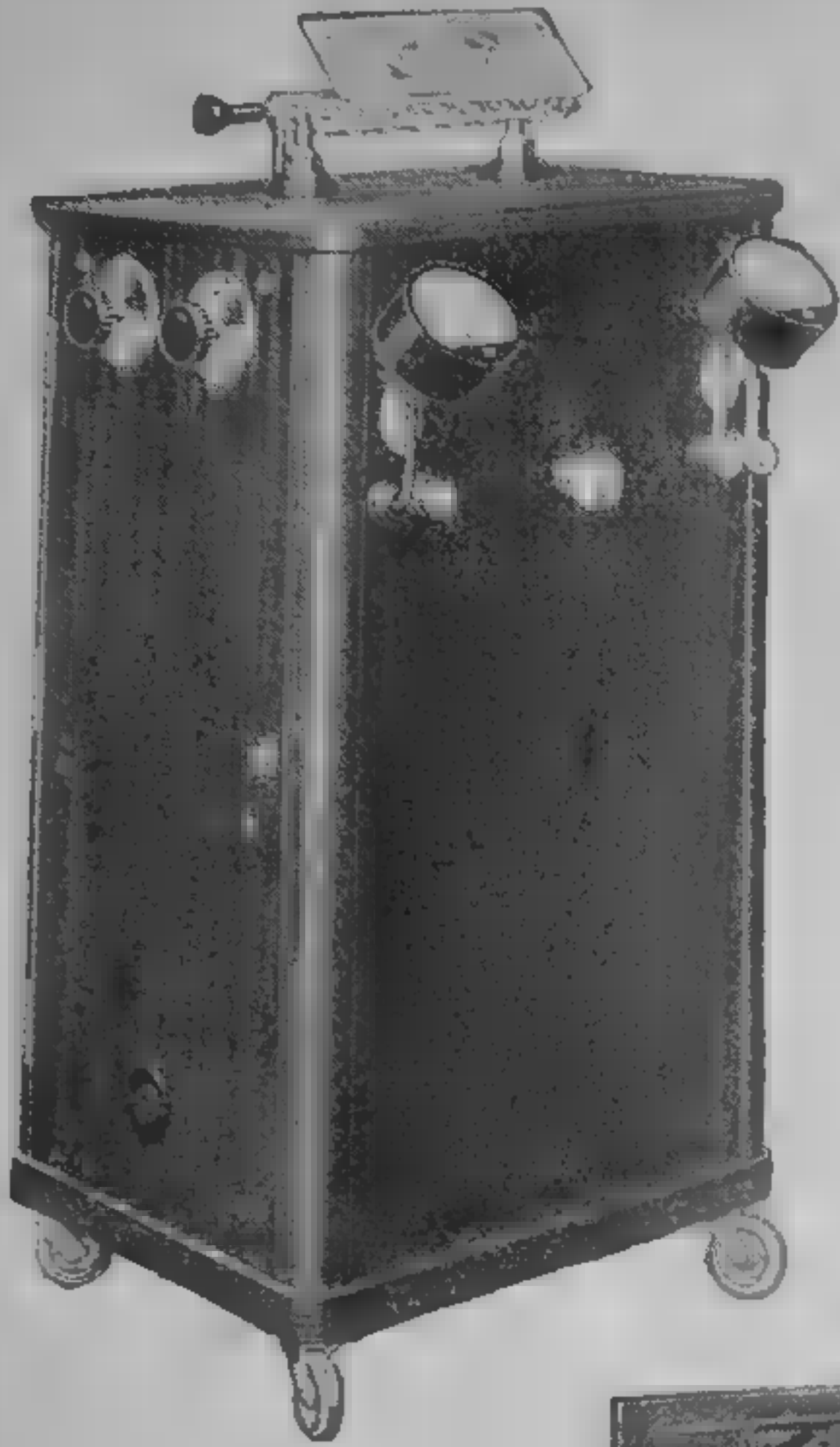
The immediate effect of auto-condensation in addition to increasing bodily heat is to lower blood-pressure and if the latter is taken before and after a treatment the average reduction will be found to be about ten points. This reduction will not be maintained and in three or four hours the pressure will be partly back to the original point and almost or quite so by the following day. This will be discussed further under the treatment of high blood pressure.

For years we have employed auto-condensation without realizing that there is a distinct difference between Tesla auto-condensation and d'Arsonval auto-condensation. Fortunately, trouble has been avoided because nearly all of the machines have been of the Tesla type and so that was the form of auto-condensation employed.

Tesla auto-condensation has higher voltage and lesser amperage or heat. The heat is of an eliminative character and increases functional activity. In fact it is our great treatment where elimination is desired and indicated in all toxemias of whatever sort. Its heat is seldom sufficient to produce organic changes. It is particularly effective in increasing the elimination of the purin bodies (urea, uric acid, creatin and creatinin), as referred to in a previous section.

Tesla auto-condensation is indicated wherever absorption of exudate is desired. Whatever other method is employed, Tesla auto-condensation should be combined with it.

The **average dose** of Tesla auto-condensation is 500 to 900 milliamperes for twenty minutes. My suggestion is to employ the amount obtained by operating the machine at about three-quarters of its full capacity. It is not so much how high an amperage is used as it is how long the current is applied; so to increase the dose, lengthening out the period of application is preferred.



Large Cabinet High
Frequency Machine,
Showing Internal
Arrangement. Ley-
den Jar Condensers.



The same amount of current through the d'Arsonval winding will give the patient a greatly increased amount of heat.

The heat in **d'Arsonval auto-condensation** is so great that it will liberate toxins faster than its eliminative power can take care of, consequently the toxicity of a patient will be increased and will be indicated by dizziness, as previously stated.

Thus it will be seen that in all conditions of toxic origin (and that pretty nearly takes them all in), where auto-condensation is to be employed, **we must start with Tesla auto-condensation**, changing over later to the d'Arsonval type, when elimination is well established.

On the other hand, the very powerful heat of d'Arsonval auto-condensation enables us to accomplish **organic changes** with it, which are not possible under the milder heat of the Tesla current. Thus, each has its place and each is equally valuable, but they must be used carefully as indicated. For instance, in high blood pressure, which is of toxic origin, the eliminative Tesla type must be employed first, but if actual sclerosis is present it will only serve as far as results may be obtained from elimination, and will not affect the sclerosis. Then comes the time when d'Arsonval auto-condensation may follow and with its powerful or diathermic type heat, actually affect the sclerosis itself if it be not too far advanced.

Whether a thick, medium or thin auto-condensation pad is used, matters little at the present time. The original form was a zinc-bottom steamer chair upholstered with a thick cushion stuffed with silk waste. I originated the first folding and long thick separate pad, and the first of the very thin pads. The thick pad has a greater condenser capacity and works well with a high-voltage current. The thin pad as now made, has plenty of capacity and is much more convenient.

The thinner the di-electric or insulating material in the pad, the closer the two opposite charges are to one another, and the greater the stress, so that the same amount of current will give a higher meter reading than with a thicker di-electric. The original objection made to my thin pad with the mica di-electric was that the condenser field was too shallow. This has been overcome by modern apparatus, and the field as now produced, is twice as much as is necessary.

The dose in d'Arsonval auto-condensation is from 800 to 1500 milliamperes.

CHAPTER SIX.

Diathermy.

Diathermy is undoubtedly the most popular form of high frequency in use, and I do not wonder at this when I see some of the astonishing things accomplished by it, nor am I surprised that a statement of these facts proves a great strain on the credulity of the physician who hears about them for the first time.

Diathermy means heating through, a name given it by Nagelschmidt, although the current employed is the original first form of high frequency produced by d'Arsonval and the method was first known as the direct d'Arsonval. Other names, such as thermo-penetration, electro-penetration, etc., have been applied, but diathermy is the one which has survived.

Heat is the great property of diathermy; heat that is produced within the tissues themselves, and which may be directed to reach any desired area.

This heat is arrived at in a different way than we are accustomed to considering. If we apply a hot water bag to a patient or place him in a hot bath, the heat is con-

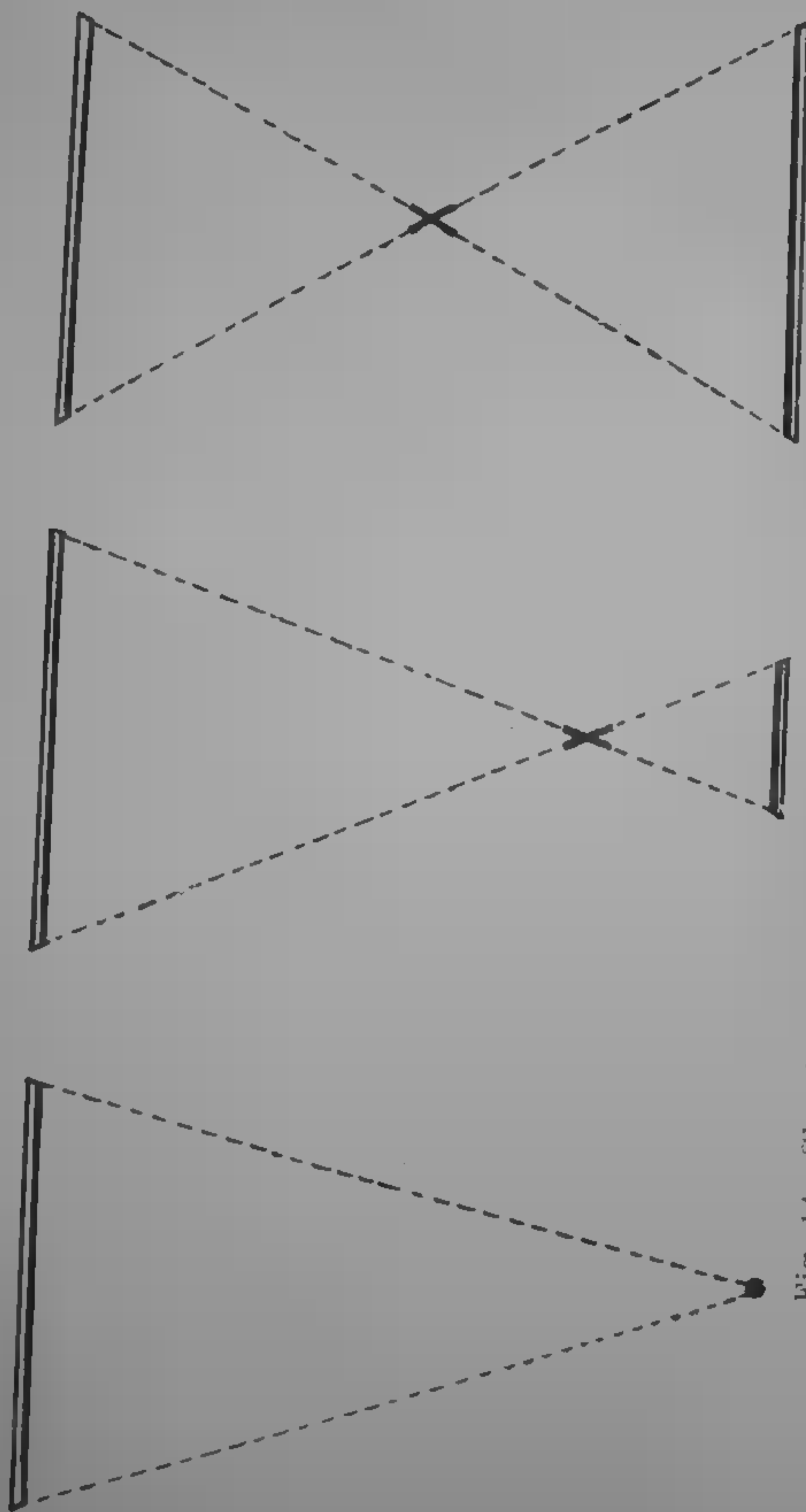


Fig. 14—Showing Maximum Heat Point with Different Sizes of Diathermy Electrodes.

ducted into the body. If a high candle-power lamp is directed on the body, we have **convective** heat. In diathermy the electrical units are converted into heat units through the resistance offered by the tissues, and we have **conversive** heat.

Let us consider what takes place when we apply diathermy with two electrodes of the same size. Recall the fact that the same amount of current is passing through each electrode, but that the current is not flowing in one direction, that is, from one electrode to the other, but is oscillating back and forth through the condenser and spark-gap, and driving in simultaneously from each electrode and passing toward the center. It may be likened to a bombardment from both electrodes. The resistance offered is producing some heat all along the course, but the greatest amount is in the center where the heat is being produced by the conversion of the current from **both electrodes**. We have been in the habit of illustrating this by drawing imaginary diagonal lines from the edges of the two electrodes, and in the middle where these cross is the point of maximum heat production and intensity. (Fig. 14.)

Since the d'Arsonval current has the lowest voltage of all of the high frequency currents, it has also the greatest amperage or heat, and is, therefore, the true and best current for diathermy.

The Tesla current is employed for the same purpose in many machines, but by reason of higher voltage, does not produce the same amount of heat. It is often mislabeled the d'Arsonval current, but should be called Tesla diathermy, and then there would be no misunderstanding.

Now the high frequency current differs from the galvanic and other low-tension currents, in that it passes in the shortest or most direct path between the electrodes, whereas low-voltage currents follow the path of least resistance.

I have often been able to show in coagulating meat or a potato, that what evidently takes place with equal-sized electrodes is that as the current is passing from each toward the middle area, the current from the center of each electrode goes a little in advance of the rest, and as these two lines meet, they establish a path of least resistance which is the most direct central line between the electrodes. The tendency then is for the rest of the current to converge toward this beaten path, and that is why we frequently see an hour-glass shaped area representing the part through which the current has passed.

From the central point of maximum heat intensity, the heat area begins to spread out toward the electrodes. This is why we are oftentimes successful in reaching a

lesion with our heat when our electrodes have not been correctly placed.

We are apt to lose sight of one important fact, and that is that the action in the living tissues is modified somewhat over that which takes place in an inanimate object, such as a potato or a piece of meat.

The living tissues have varying degrees of resistance and we have the blood stream which is a good heat conductor to carry off some of the heat from the point where it is generated. It is probable, therefore, that could we see exactly what takes place in the living body, we would see many laterally diverted points of heat intensity projecting away from the maximum point.

Bones offer the greatest resistance to the passage of the current, and so are slower to heat, but retain the heat longer. Fat is next in its resistance. The skin is usually least resistant. The heat will naturally become greater in less time in the soft tissues by reason of their lessened resistance and in a sense we might consider that the current travelled around the bone, following the easier path offered by the other structures.

Going back to our original test with two even-sized electrodes, let us now see what will happen if we make one electrode one-fourth the size of the other. By drawing in our diagonal lines, we find that they cross one another one-fourth of the way in from the smaller electrode.

If the smaller one is one-third the area of the larger, they will cross one-third of the distance in from the smaller electrode. Thus it is seen that through regulation of the size of the electrodes we may produce our area of maximum heat at any desired point, making some allowance for the character of the tissues.

The foregoing statements should be modified somewhat by using the term "approximately." That is we may localize our heat **approximately** where desired within the tissues, and do not overlook the effect of heat conduction through the blood stream.

If now, we make one electrode a point or a small disc, since this small area must handle as much current as the larger electrode, the current intensity or heat becomes too much for the resistance of the tissues and cooking or **coagulation** takes place. When this destructive action occurs we call it **surgical diathermy**. When the heat is not raised above the toleration of the tissues it is called **medical diathermy**. There is a point close to toleration but short of coagulation, which might be called **bactericidal diathermy**.

There are some germs that have a thermal death point below that of normal cells where this fact may be taken advantage of for the destruction of the bacteria. A notable example is the gonococcus which has a thermal death-point around 104° Fahrenheit and it is therefore

destroyed by maintaining a temperature of 108° or 109° with diathermy. At 113° the gonococcus is instantly destroyed.

On the other hand, there are many germs such as certain types of streptococci whose heat resistance is above the danger point to normal cells and they cannot be destroyed by diathermy. Of course diathermy undoubtedly calls forth some increased natural physiological resistance or aids in the production of anti-bodies. That evidently gives it some indirect germicidal power in addition to the direct influence of the heat generated, which also leads me to express the opinion that we will ultimately ascertain that diathermy possesses properties in addition to those of merely generating heat, but which have not yet been clearly established.

Medical diathermy has been divided into two types, **Sedative** and **Stimulative**. In ordinary practice we will use the sedative type a hundred times or more to one where the stimulative method is required.

Sedative Diathermy. In this form of medical diathermy we slowly run up our current to the maximum dosage we have decided on. This dosage is always based on the size in square inches of the smaller electrode. Let us say that we are going to give 800 milliamperes as our full dose. If the metal electrodes are taken out of hot water so they are at approximately the temperature of

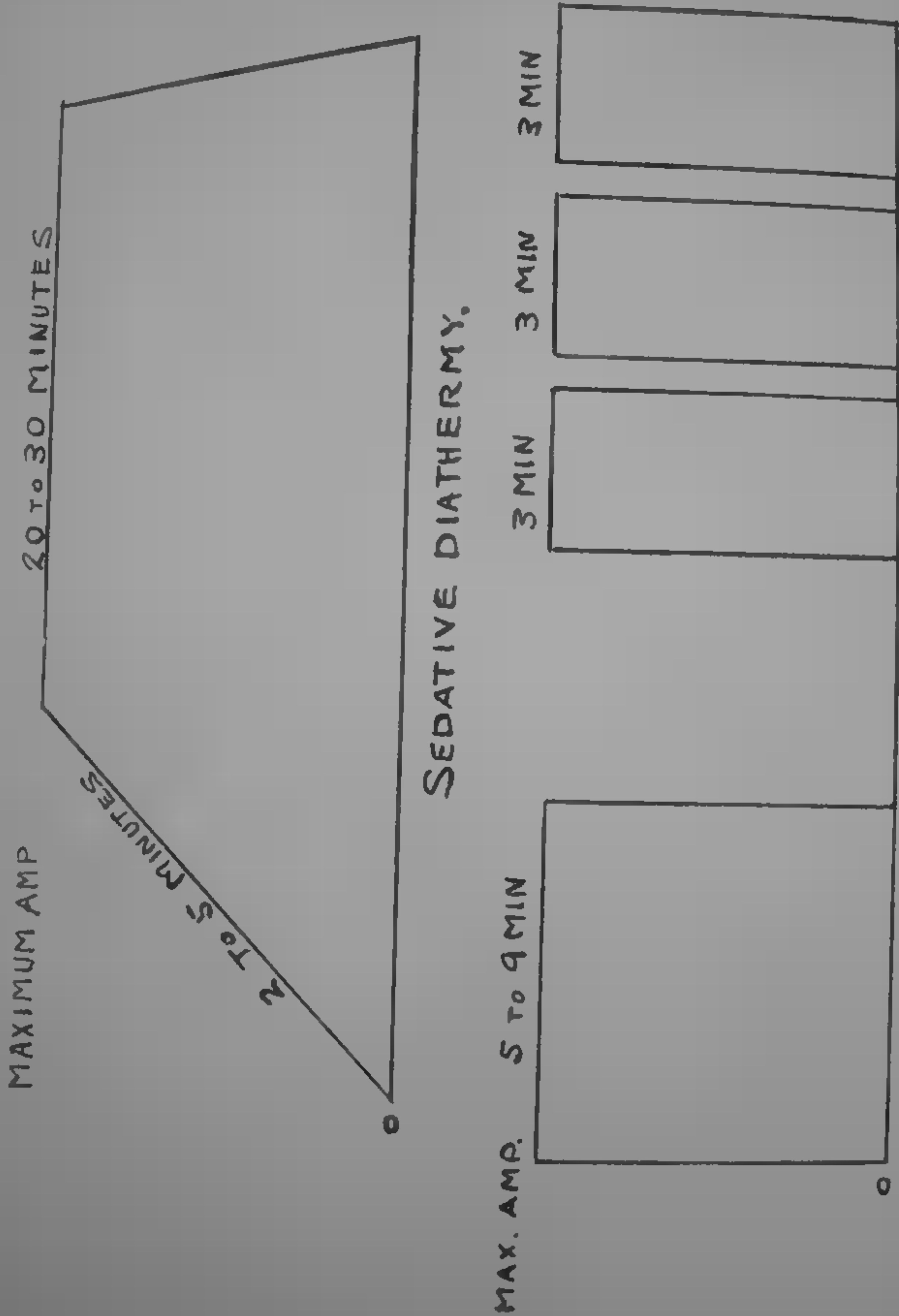


Fig. 15—Graphs Showing Amperage Range in Sedative and Stimulative Diathermy.

the skin, we take two or three minutes to run up to 800 milliamperes. If we start with cold electrodes it is better to take about five minutes. After 800 is reached the dose is maintained for twenty or thirty or more minutes, thirty being the average, and then about one minute consumed in slowly coming back to zero. The amperage line is shown in the accompanying graph. (Fig. 15.)

The reason for the gradual turning on of the current is so that we may not set up increased skin resistance or awaken antagonistic reflexes to resist the entry of the current and its conversion into heat. We are trying to gradually slip by body defenses and slowly build up the requisite amount of heat.

The gradual turning off of the current, I am inclined to think, is of greater theoretical than of practical importance and I often disregard it in my own practice.

Stimulative Diathermy is just the reverse. Here we desire to stir things up as much as possible and to call out all available reflexes. Having decided on our dose, which should average about one-half of the maximum limit possible, we abruptly run the amperage up to this amount, hold the current on from five to nine minutes and then abruptly turn it off. A still more effective way is to turn it on for three minutes, then off, and in half a minute repeat, giving say three of these three-minute

periods. The principle in stimulating diathermy is to make it **short, sharp and snappy**.

Rules for Dosage of Diathermy. There are three well-defined rules for the computation of the dose of diathermy to be employed. These follow Joule's Law. The first rule is that the maximum dose employed shall not exceed 100 milliamperes per square inch of the surface area of the **smaller electrode**. Beyond this point coagulation will take place in most individuals, so this is the danger line. The dosage is always based on the size of the smaller electrode because here is the greatest density of current. In earlier years to increase our dosage we tried to do so by increasing the amperage and thereby often came to grief. Therefore, to be on the safe side we decided to establish a margin of safety between the dose we regularly employed and the maximum limit which might occasionally be approached and therefore we use ordinarily from two-thirds to three-quarters of the maximum dose or say from 65 to 75 milliamperes per square inch of smaller electrode. For example, an electrode 3x5 inches would have 15 square inches, therefore the maximum dose would be 1,500 milliamperes and the average dose from 975 to 1,125 milliamperes.

The second rule is that the intensity of the current varies in indirect proportion to the increased amperage.

This needs a word of explanation. If we were giving,

for example, 200 milliamperes and we ran the current up to 400 milliamperes or twice the original amount it would at first appear that the intensity would be twice as great, when in reality it is **the square of the increase** or two multiplied by itself and therefore four times the intensity. If it were run up to 600 which would be three times the first dose, the intensity would be nine times as great (3×3). This gives us an additional reason for our margin of safety because it readily will be seen that when we get up into the higher figures the intensity increases decidedly for every additional hundred milliamperes.

The third rule and the one which gives us the opportunity of securing all the heat required without subjecting our patient to any serious danger, is that the heat varies in direct proportion to the length of time. **More time, more heat.**

From this it would appear that whatever the dose employed, if a sufficient time elapsed we would finally secure an adequate amount of heat. Of course if the dose was too small it might take hours and so we have our average dose an amount that usually will produce the appropriate heat in about half an hour.

The principle involved in this third rule is comprehended readily by thinking of two tea-kettles of water, one of which is over a slow wood fire and the other over a large gas flame. In either case, the tea kettle will boil

but with the slower fire it will take considerably longer for the heat to raise the water to the boiling point.

This rule also explains how a dose that for some time is not noticed by the patient will suddenly begin to be too hot, and necessitate a reduction in amperage.

Patient's Toleration. No matter what the dose employed may be, if the patient says it is too hot, pay attention to what he or she says and avoid trouble. Idiosyncrasies to electricity exist as well as to other therapeutic measures and then there may be some fault in your technique.

Suggestions. As a rule, the smaller the spark-gap distance you can employ and get your required dose, the smoother the current will be.

Introducing accidentally or otherwise an additional spark gap in the patient's circuit, will give a faradic sensation to the current in either auto-condensation or diathermy.

A fluctuating needle on the meter indicates some break or poor contact point in the circuit or an imbalance between volt-controller and spark-gap.

Preparation and Adjustment of Electrodes. The electrodes are made principally from block tin, the 22 gauge being used more than any other size. The 26 gauge is thinner and will adjust easier over uneven surfaces. Mesh

and lead foil are used also and sometimes the covered electrodes of all the kantbern type.

In addition any metal electrode may be used for special areas, such as for vaginal or rectal applications.

The electrodes are cut from the block-tin in suitable sizes, the point to be kept in mind being that the surface to be applied to the patient must be absolutely smooth, as perfect approximation of the electrode is essential. Corners are rounded or bent over and rough edges smoothed with back of scissors or with emery paper. (Fig. 16.)

An excellent method is folding back a narrow margin all along the edge, giving absolute smoothness and also firmness. A flap, or tail piece is provided for the attachment of the metal clip which carries a socket for the insertion of the conducting cord. Sometimes sockets are soldered on.

If electrodes become bent and uneven they are smoothed out easily with a rolling-pin or a heavy round bottle. They are easily sterilized by boiling or by immersion in antiseptic solutions and when they become dark and corroded may be freshened by boiling up with a little soda in the water.

When applying the flat electrodes to the body they should be placed opposite and facing one another as nearly as possible and a mental calculation should be made



Fig. 16—Method of Improvising Diathermy Electrodes from Block-Tin.

concerning where the imaginary diagonal lines from the edges would cross to see whether this point will be where the maximum heat is desired. Electrodes must be ap-

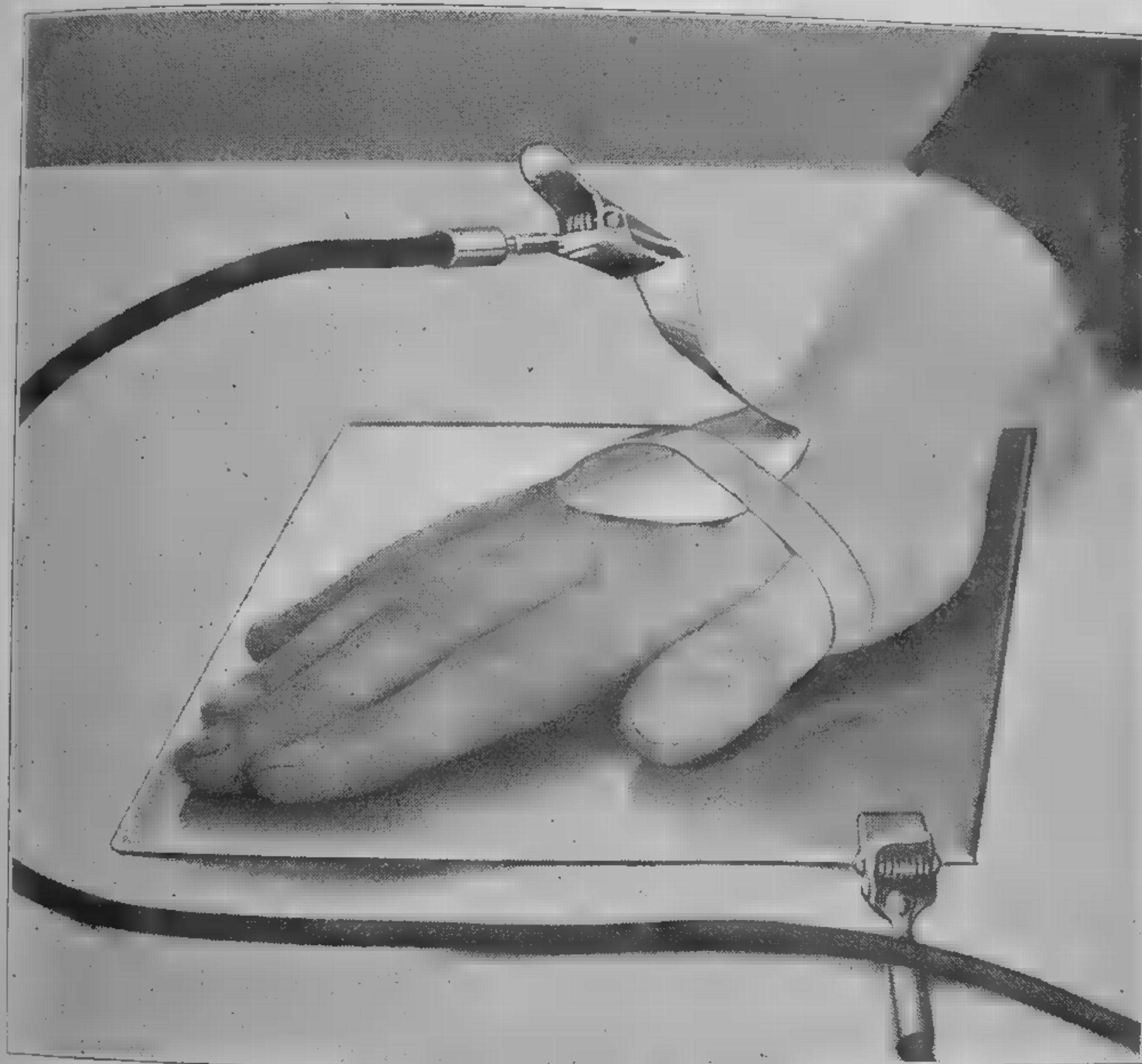


Fig. 16a—Method of Improvising Diathermy Electrodes from Block-Tin.

plied directly to the skin and fit closely so that no little sparks can pass from the electrode to the patient as these “jump-sparks” produce burns. Soap lather has been used for aiding in close approximation. When used it is

desirable to lather both the skin surface and the electrode, the two lathered surfaces insuring better adjustment than if the skin alone is covered. There is no objection outside of the bother, to the use of soap lather at any and all times, but more recently it has been found unnecessary in many of our cases. Usually taking the electrode out of hot water with the few drops clinging to it

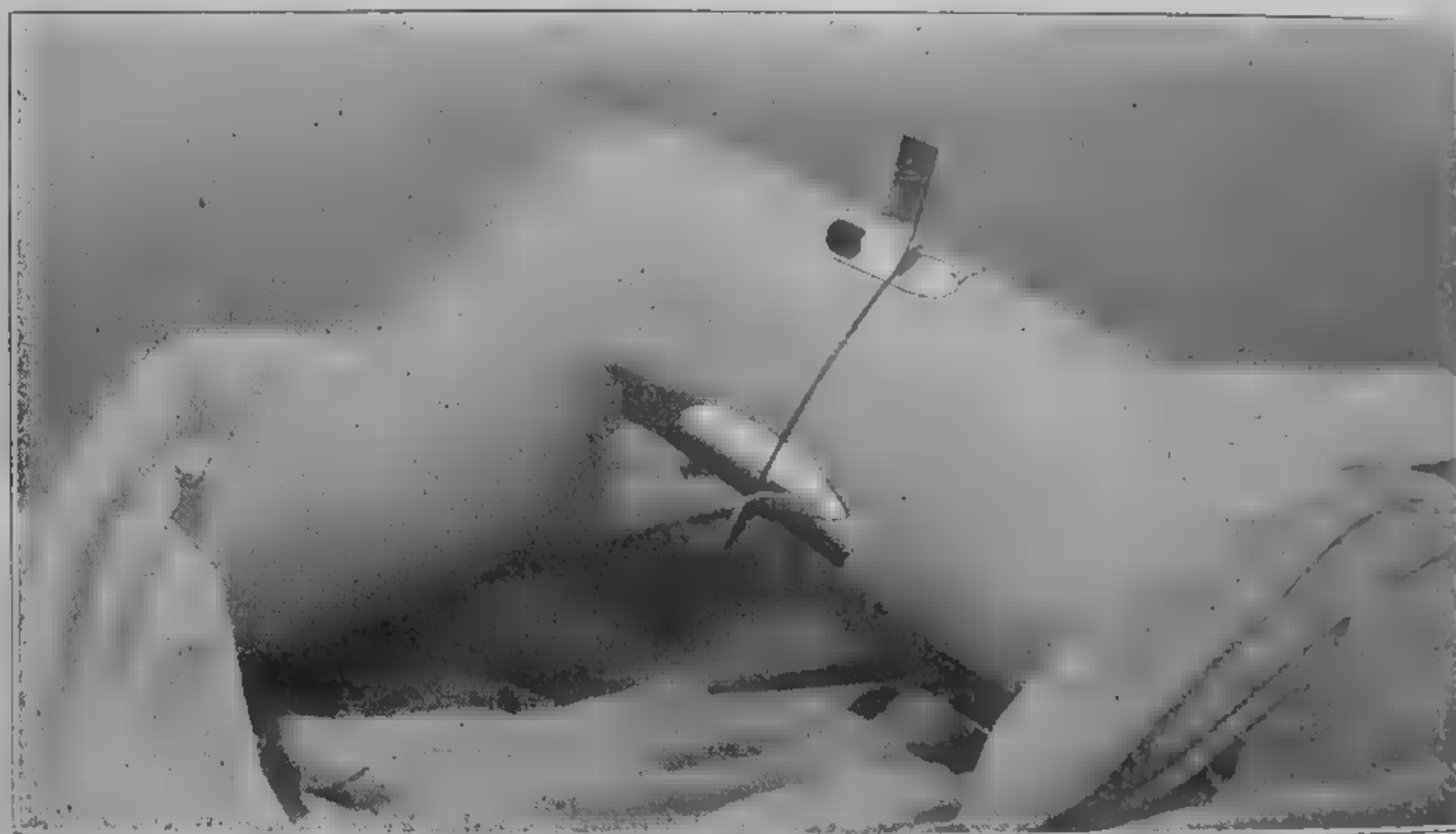


Fig. 16B—Method of Improvising Diathermy Electrodes from Block-Tin.

and placing it on the skin will give sufficiently close contact and as the current is turned on slowly the patient will soon furnish in the form of perspiration, enough moisture to insure definite approximation. If the surface be a hairy one, as for instance, the chest, then the hair will have to be lathered thoroughly to make it a con-

ductor, otherwise it separates the electrode far enough from the skin to permit sparks to pass.

Some operators use a layer of well-saturated chamois skin under their electrodes. I prefer contact directly with the skin.

If the skin is oily, it should be cleansed. Oils and fat interfere with the passage of the current. If there is an abrasion of the skin, cover it with collodion as it will offer less resistance than the unbroken skin. Scar tissue also has only about one-third the resistance of normal skin. If a sharp edge or point from the electrode presses down into the skin, it produces a local anemia, and greater heat will accumulate.

Various methods are employed for holding the electrodes in place and it often will tax your ingenuity to secure suitable adjustment in some localities.

When treating the chest or abdomen the patient usually lies on the table on the larger electrode, a cushion or pillow under it to serve to adjust it to the curves of the back. The anterior electrode is held in place by the weight of a sandbag. Sandbags should only contain about half the sand they will hold, thus they will flatten out over the electrode and not roll. Loose covers for sandbags which may be laundered are an aid to cleanliness and sanitation.

Rubber sponges have been found very convenient in



Semi-portable Diathermy Machine.

aiding in getting good electrode contact. Hot water bags are also satisfactory.

In treating the back it is easier to have the patient lie face downward on the larger electrode and have the smaller one on the back held by the sandbag.

In some places it is easier to retain electrodes by binding them on with an ordinary bandage, with elastic bandage, or with strips of rubber or chains of rubber bands. In using ordinary bandages do not bind too tightly. Make allowance for the slight swelling produced by the heat of the current.

I have found that strips of adhesive are at times useful in securing small electrodes in place.

Where the indifferent electrode is to be of large size, the folding thin auto-condensation pad may be used for it.

General Action of Diathermy. The general action of diathermy is that of mild, medium or powerful heat definitely localized and produced within the body itself.

There is a stimulation of the circulation, both arterial and capillary, increasing the size of the blood-vessels and increasing internal heat. The lymph channels are also dilated and there is serous effusion in the areas surrounding the blood-vessels. General metabolism is increased, phagocytic action is stimulated, and there is a general relaxing or anti-spasmodic effect and the relief



Portable Diathermy in Two Convenient Suit-case Units.

of pain. The latter probably being due to the direct influence of the heat on the nerve-terminals.

There is the softening effect of heat upon fibrosis and upon exudates, in fact the well known solvent and liquefying action of heat.

Bacteria are affected both by the stimulation of phagocytosis and the direct influence of powerful heat.

Contra-indications. Because of the distension of blood vessels produced by diathermy it should not be used where there has been a recent hemorrhage. Thus although its use immediately following an apoplexy would be indicated for promoting softening and absorption, it would be unsafe to employ it at this time because of the danger of causing additional hemorrhage.

Similarly in pulmonary tuberculosis when hemorrhages are threatening or occurring it should not be used.

It is not employed in gastric or duodenal ulcer.

When pus is confined in a limiting wall or sac, diathermy is never used because of the danger of rupturing the sac.

Ordinarily diathermy is not applied locally through the pelvic organs when a woman is menstruating, because it increases the flow. On the other hand, in scanty menstruation it would be alright.

It may be used cautiously during the first three months of pregnancy but not afterward.

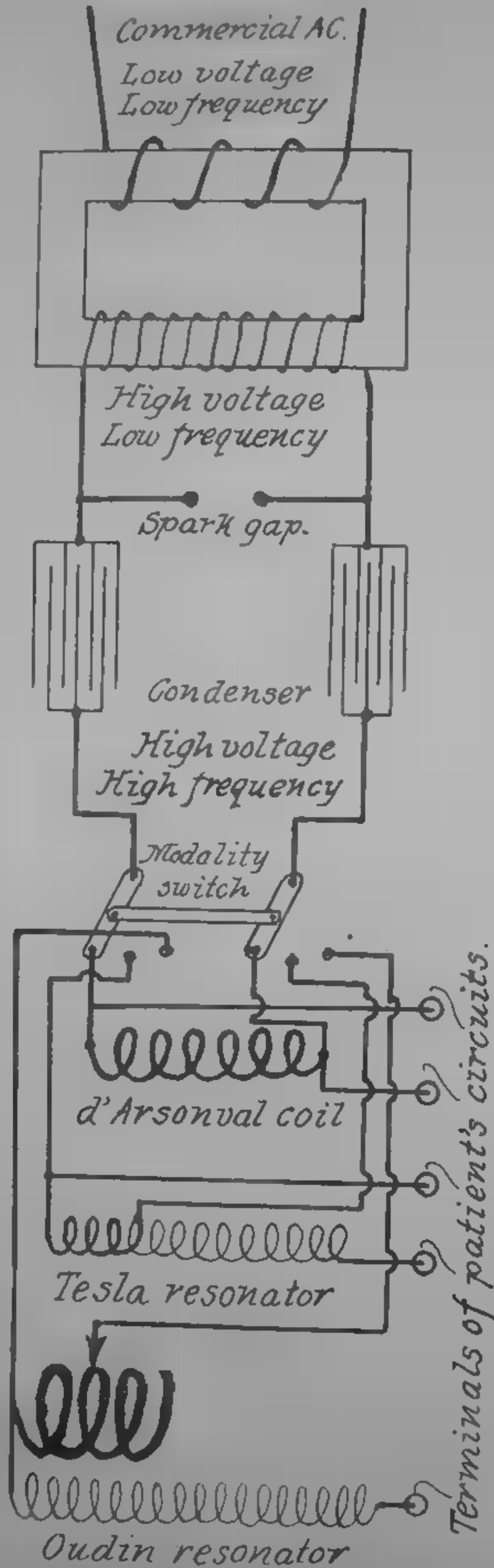


Fig. 17. Diagram Showing how High Frequency Currents are Evolved.

CHAPTER SEVEN.

How the High Frequency Currents Are Produced

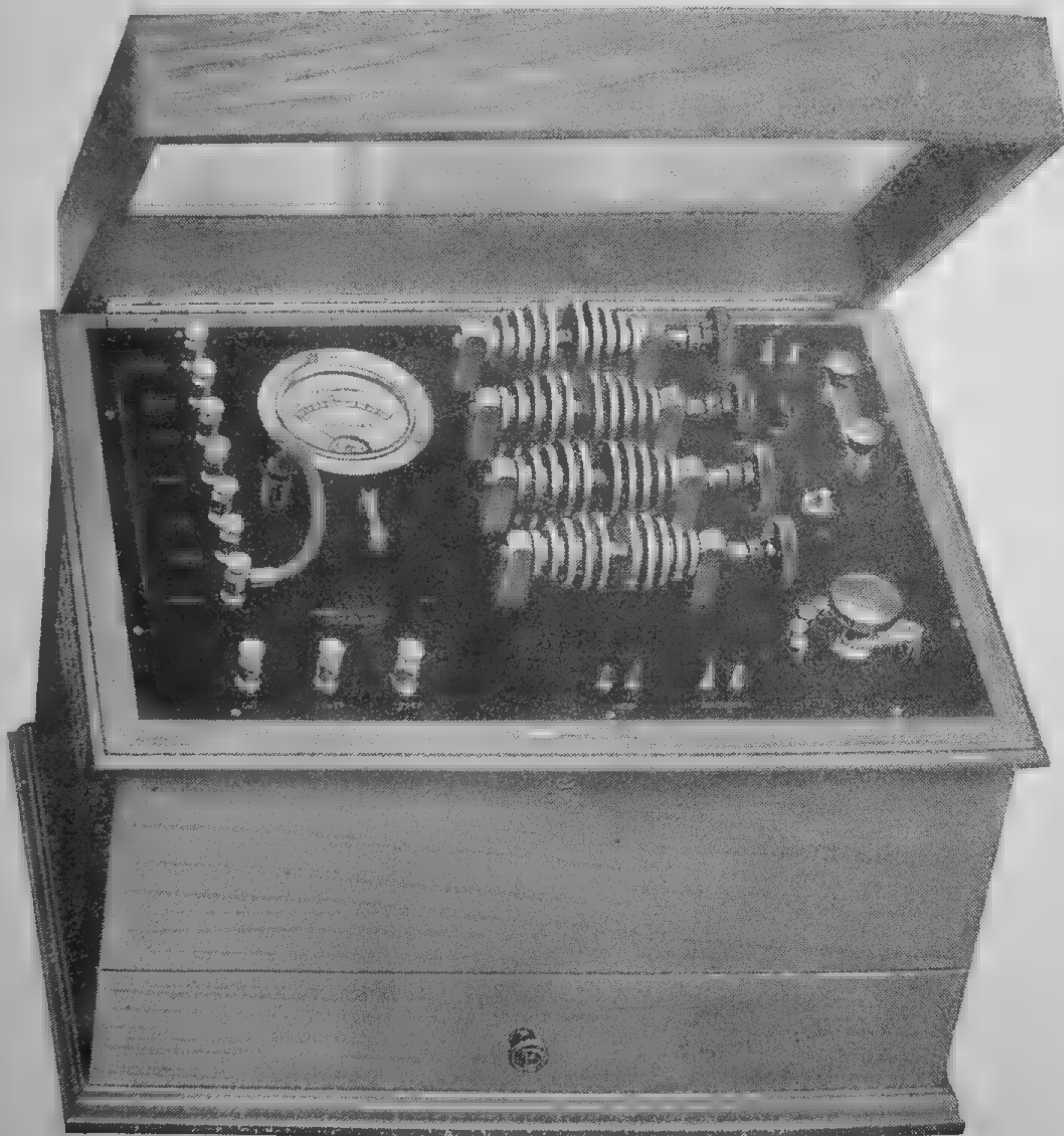
Essentials. In any high frequency apparatus the three essential features are transformers, condenser and spark-gap.

The transformers raise or lower the voltage of the current, the spark-gap regulates the filling or building up of the charge in the condenser, and the condenser governs the frequency of the current.

It is desirable that the physician should understand the evolution of the current and be able to look inside of his apparatus and see whether the necessary combination exists to give the desired currents.

High frequency machines operate on the alternating current, the ordinary 110 volt, 60 cycle current being the best for that purpose. When the supply is the direct current, it is necessary to pass it through a rotary converter to produce an alternating current.

The line current passes into the transformer and this is so wound that ordinarily the 110 volt low frequency current is stepped up to about 35,000 volts at maximum



Diathermy Coil.

capacity. No change is made in the frequency, which is still low. It is then carried through the spark-gap into the condenser where its frequency is raised to from 800,000, to sometimes as high as 3,000,000.

When the current is delivered from the condenser it will then be of comparatively high voltage and also high frequency and will have become an oscillating current. From this neutral point the current is then, by means of a selector switch, carried through the necessary transformation or windings to produce the three typical currents, the Oudin, the Tesla and the d'Arsonval. (See diagram, Fig. 17.)

In the Oudin the current is one of from 60,000 to 90,000 volts, therefore the 35,000 volt current must be stepped up again through another transformer to raise it to the necessary voltage. This style of transformer is known as a resonator, because the secondary coil is of the resonator type.

For the Tesla current with its average of 35,000 to 45,000 volts, the transformer which is usually of the "pan-cake" or watch-spring type, does not raise the voltage very much but refines it into a smoother current. When it comes to the d'Arsonval or true diathermic current we are confronted with a different proposition. Here the voltage should be about 10,000 to 12,000 volts and we have already 35,000 volts, so it is necessary to

lower the voltage by passing the current through a coil of coarse wire called a solenoid. This reduces the voltage and increases the amperage. In many machines, instead of putting in a separate coil, this is accomplished by utilizing the primary coil of the Tesla or Oudin transformer. This lowers the voltage usually to about 20,000 volts but is not a true d'Arsonval current.

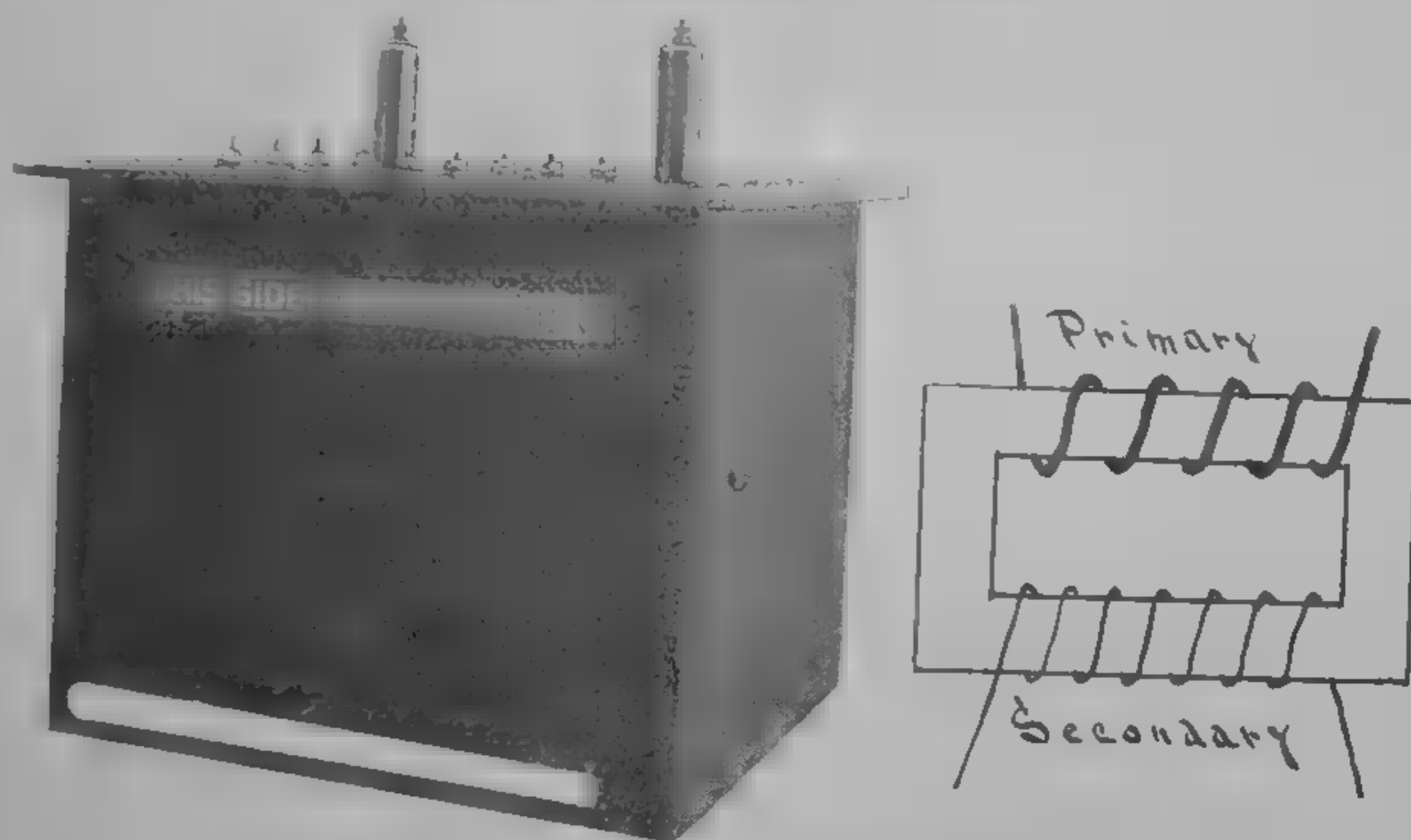


Fig. 18—Closed Core Transformer.

The Transformer. The transformer which raises the line current from 110 to 35,000 volts is usually of the closed-core type, which prevents loss of current. The ratio between the primary and secondary winding is mathematically computed and in order to raise the voltage to the desired degree, a couple of miles of wire is often wound into the secondary.

The primary consists of a comparatively few turns of coarse insulated wire wound on one shank of the soft iron rectangle which constitutes the core and which is made up of various plates fitted together and dove-tailed at the corners to make an oblong square or "picture-frame" type.

The raising of the voltage depends directly upon how many more turns of wire there are in the secondary than in the primary coil. The wire in the secondary is finer but this has nothing to do with induction.

Both the primary and secondary coils are insulated from the core and then the whole transformer is placed in a semi-fluid possessing extremely high insulating qualities and thereby obviating any undue heating and consequent loss of energy. So much for the initial transformer.

When it comes to additionally transforming the current from the neutral point referred to in a previous section, to produce the typical currents, other forms of transformers are employed.

For the Oudin current, with its extremely high voltage, the transformer produced by Oudin and named after him, is what is known as a resonator (Fig. 19.) It consists of about half a dozen turns of very heavy, bare wire, the turns insulated from one another by a considerable distance, averaging an inch. This coarse primary coil surrounds the lower end of the secondary or res-

*From high tension
transformer*

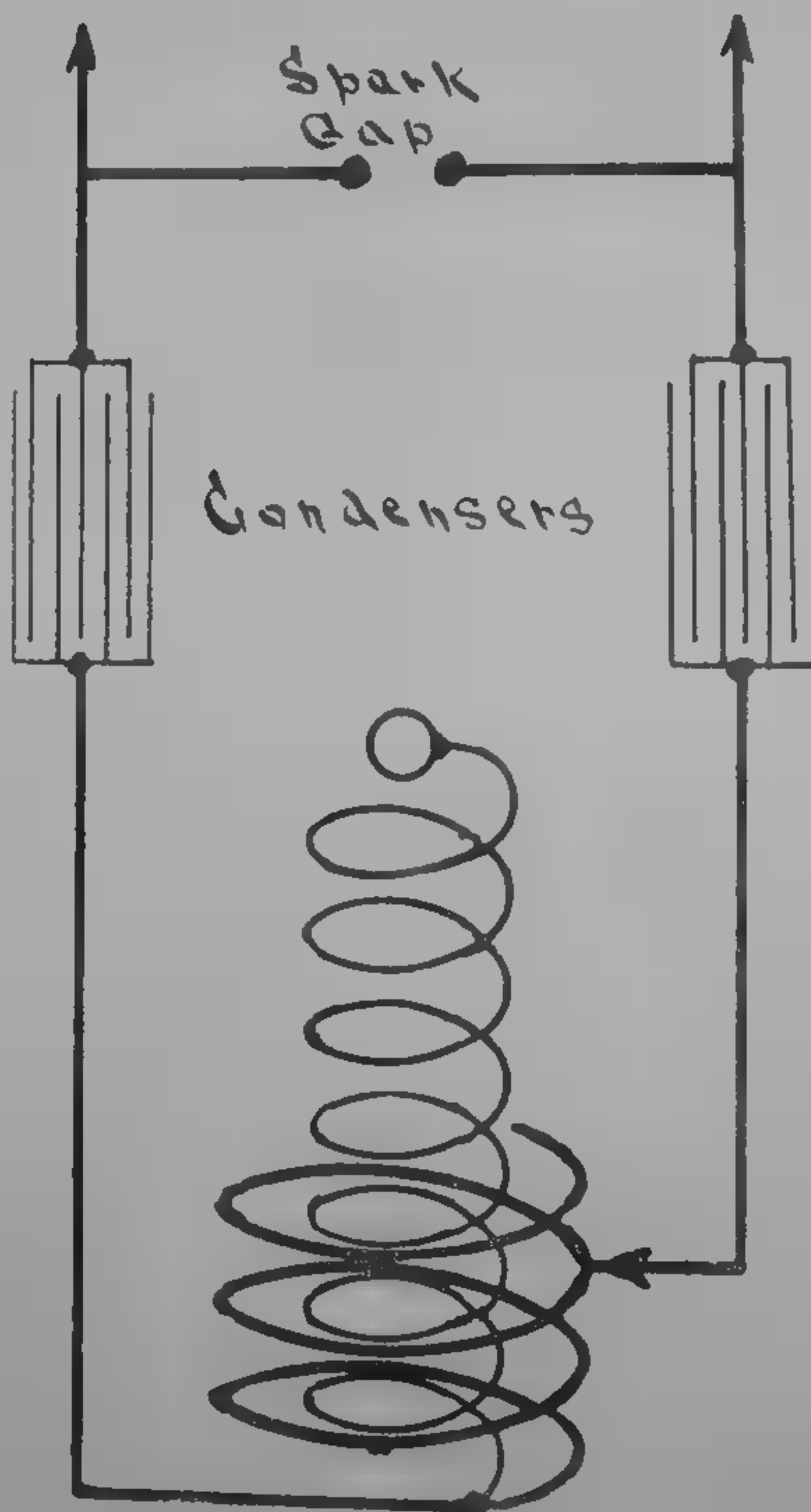


Fig. 19—Oudin Resonator.

onator coil and is sufficiently large in circumference to have the intervening air space serve as an insulator between the coils. The resonator or secondary coil consists of many turns of fine insulated wire, and terminates in a knob at the top. The voltage is so high that this coil must be outside of the cabinet or the current will leak into other windings and the upper end must also be well-removed from the upper turn of the primary coil. By definite mathematical calculation the ratio between the two coils is such that the electrical current is further enhanced by the two coils being in tune and operating on a method similar to that of resonance in sound, hence the name resonator. This transformer gives enormous voltage but very slight amperage. The volume is only sufficient to be used in a unipolar manner from the knob-terminal at the top of the resonator. A device called a tuning arm, for including all or only part of the turns of wire in the primary, regulates the volume of current.

The Oudin resonator acts partly by induction and partly by conduction.

In the Tesla current the transformer consists of three or four outside turns of coarse wire as a primary and a number of fine turns as a secondary. The whole wound like a watch spring. (Fig. 19a). In this transformer the end of the primary connects with the secondary.

In most machines the terminal of the Tesla secondary

*From high tension
transformer*

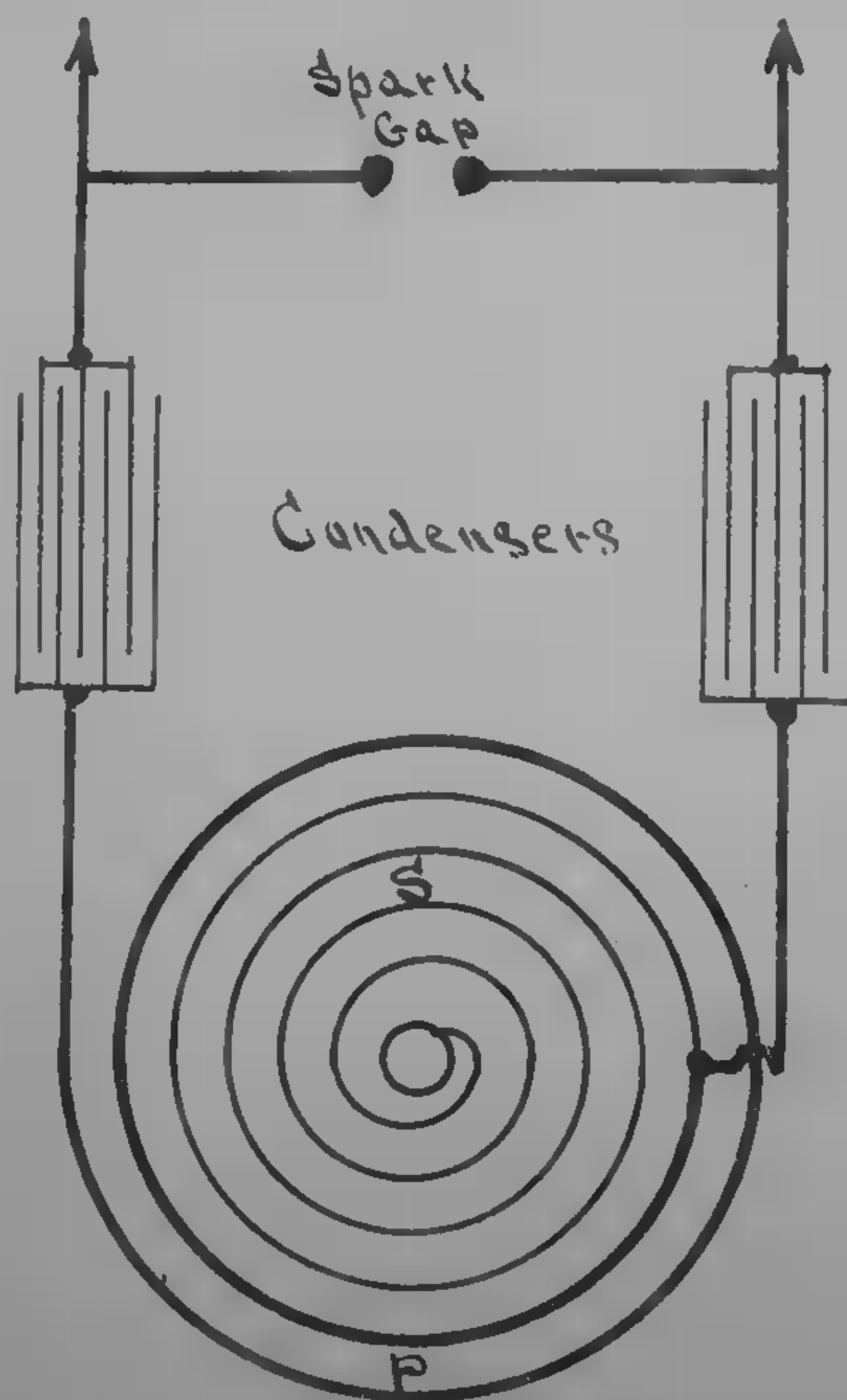


Fig. 19a—Tesla Coil.

goes to the large knob on the outside, to which attachment is made for the uni-terminal Tesla current. This is where the cord to a vacuum or non-vacuum electrode is attached or where the connection is made to the handle holding the needle for fulguration. In indirect Tesla the auto-condensation pad is attached to this terminal. It gives a current of medium voltage (35,000 to 45,000 volts), thus having a lower voltage than the Oudin current but a higher amperage. It is sometimes wrongly labeled or called an Oudin current.

In Tesla auto-condensation the pad is attached to the terminal from the secondary coil and from the terminal of the primary. The current is carried through the meter and then to the electrode in contact with the patient's body. Thus the entire output of the Tesla coil is employed. If there are terminals that just take in the primary coil, then connecting to these gives Tesla diathermy, the primary coil acting like a solenoid to lower voltage and increase amperage. It gives a good diathermic current but of higher voltage and lower amperage than d'Arsonval diathermy.

Finally, in the d'Arsonval current, where it is necessary to materially reduce the voltage, it is properly done by using a solenoid or coil of coarse wire consisting of a good many turns. (Usually about 20 to 25.) The wire is bare and the turns a reasonable distance apart. This

*From high tension
transformer*

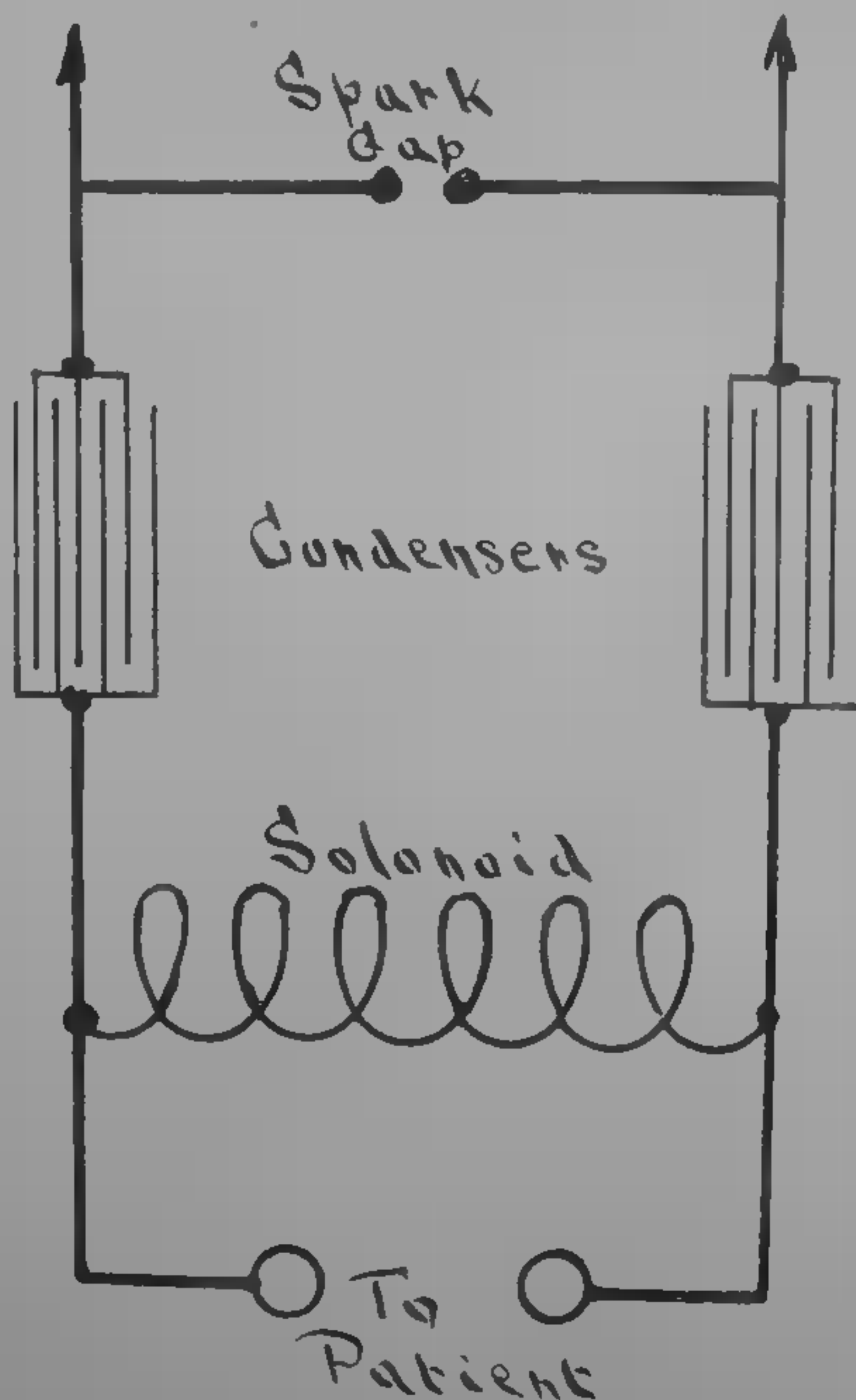


Fig. 19b—d'Arsonval Solenoid.

is a primary coil and being of much larger wire and fewer turns than that in the secondary of the original transformer, it steps the voltage down to the 10,000 to 12,000 volts required for the d'Arsonval current. (Fig. 19b).

The d'Arsonval current is always bi-terminal. It gives the greatest amperage or heat because it has the lowest voltage, and is the true diathermic current. 10,000 to 12,000 volts appears, to be the lowest practical voltage to employ. If lower, the current is apt to take on a faradic character. The terminals tap the solenoid on both ends to give the complete output. There is usually a middle tapping to include about one-third of the solenoid. Using this much of the solenoid gives a mild current suitable for use with small electrodes. If the middle and right hand terminal is used it covers about two-thirds of the coil and is a medium current.

The Spark Gap. In some portable machines a lower voltage has been successfully employed. This very important part of the apparatus controls the charge in the condenser. By interposing air-resistance it builds up the charge to any desired degree. It must, therefore, be able to stand an enormous amount of heat, and to have sufficient sparking surface to take care of the condenser discharge. Obviously a small surface would render inefficient a condenser of considerable capacity. The spark-gap has been called the lungs of the machine.

Many forms of spark-gaps have been manufactured, of more or less value. The present preference is for one that is simple and uncomplicated, both mechanically and electrically, composed of high refractory or heat-resist-

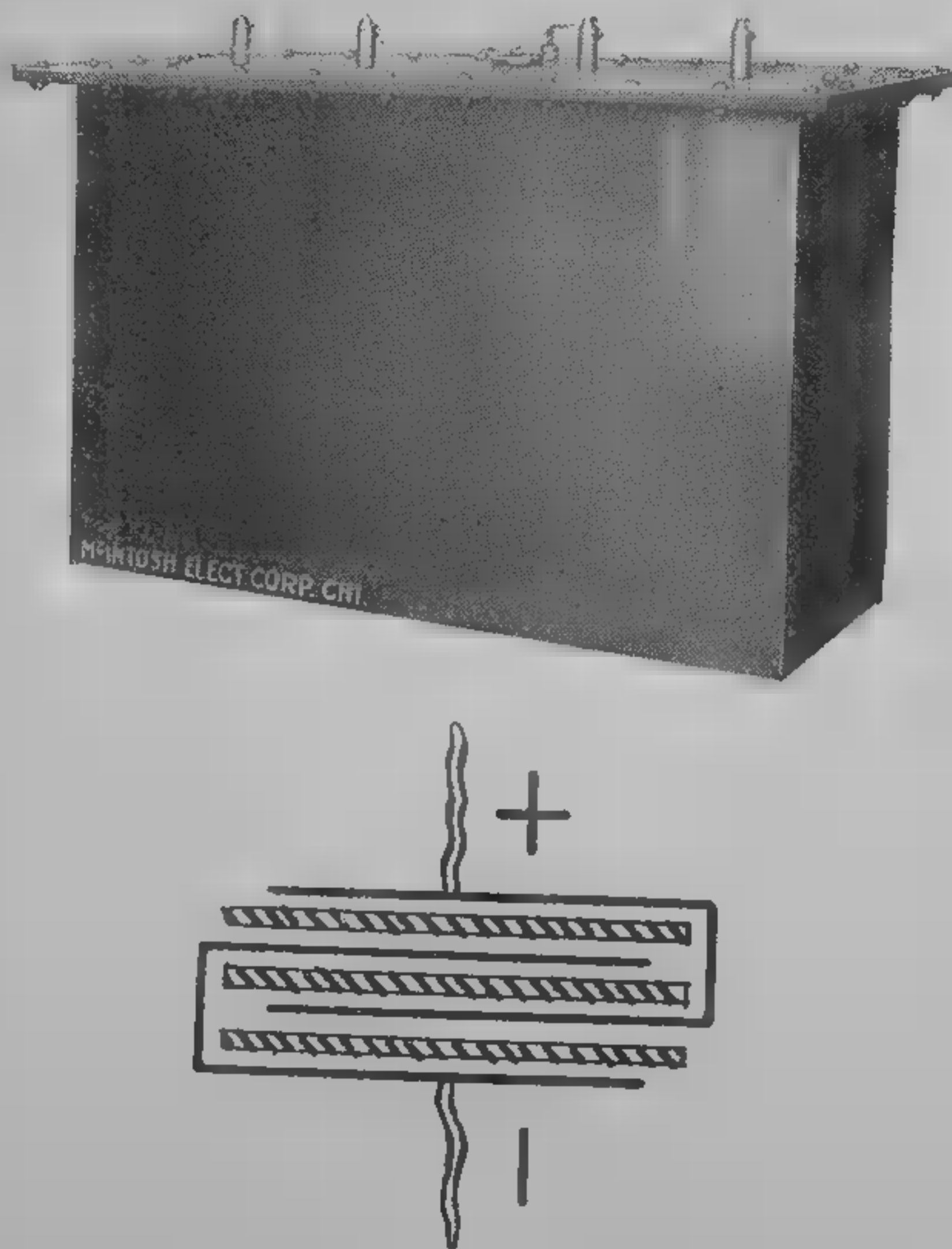


Fig. 20—Plate Condenser.

ing metal, air-cooled and non-oxidizing. It must possess adequate sparking surfaces. This gives a gap that will maintain a high rate of efficiency, capable of being operated constantly for hours, and requiring little or no care, cleaning or adjustments.

The Condenser. The condenser is a vital part of the apparatus for it controls the frequency of the current. I have been accustomed to say, in my classes, to impress this point, "**The condenser puts the frequency into high frequency.**" (Fig. 20).

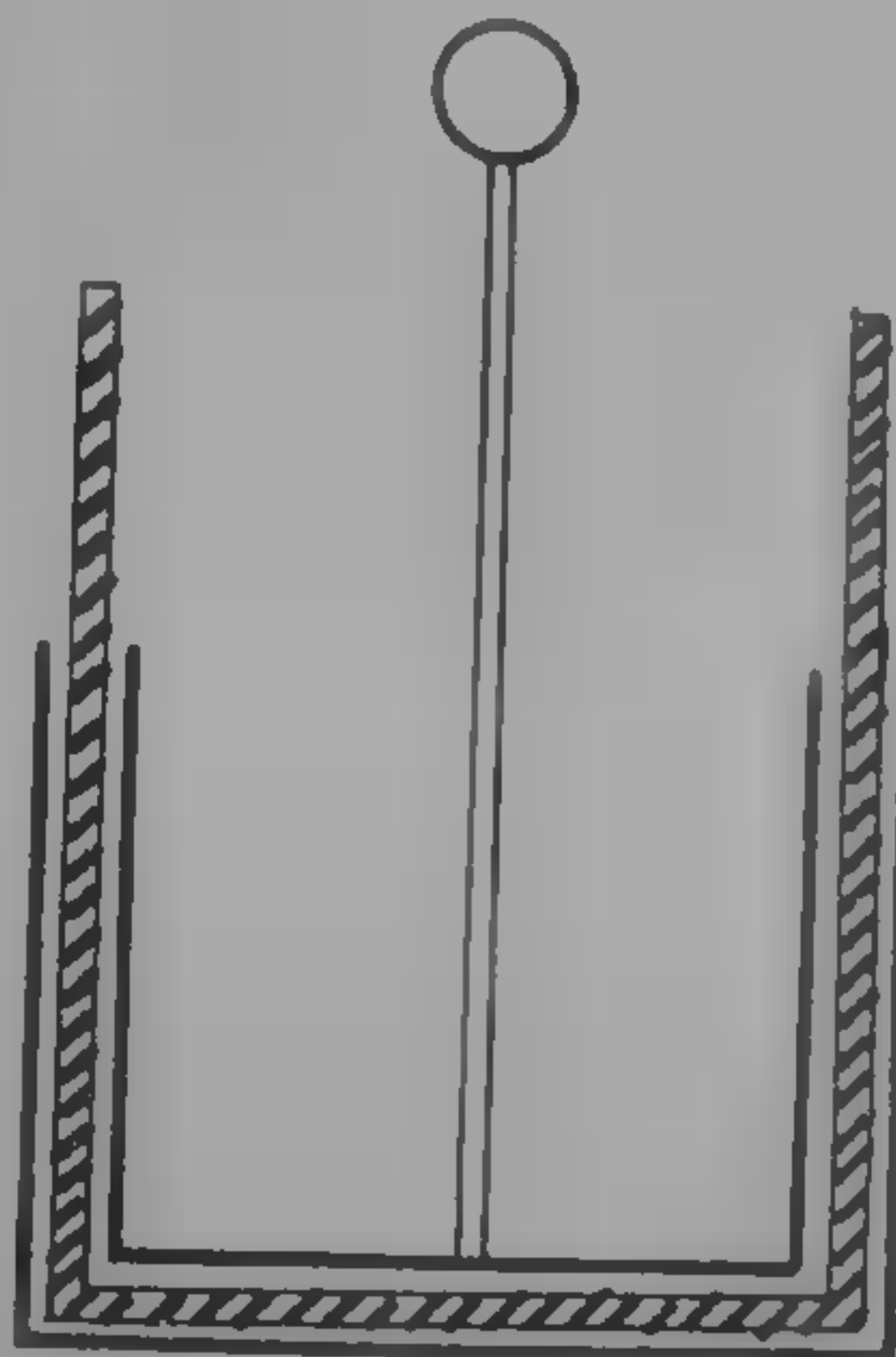


Fig. 21—Leyden Jar.

The initial condenser discharge or discharging point is fixed by the regulation of the spark-gap and is followed by a multitude of oscillations as a result of the inductive action of the condenser or what is known as "electrical oscillation." It is the number of these oscillations between the peak condenser discharges that consti-

tutes the frequency of the current. In the larger machines this runs up to about two and one-half million.

It also explains how a small machine can never have the frequency of a large one because there is not room for a condenser of sufficient capacity, in fact in cases of variable frequency lowering the latter lessens capacity.

The original form of the condenser was the Leyden jar (Fig. 21), which in its early form consisted of a wide-mouthed bottle, with a layer of lead-foil on both the inside and the outside, these layers extending up over less than half of the sides of the jar. When a positive charge of static electricity was placed on the inner layer, a negative charge immediately appeared on the outer layer, induced or held there by the attraction of the positive charge. The opposite charges attract one another but cannot get through the glass to neutralize. The glass is called a **di-electric**. The electricity acts through but cannot get through. The charges on the foil are crowded or condensed on the surface, hence the name condenser.

This relationship of two surfaces carrying opposite charges of electricity and separated by a di-electric, is the characteristic of a condenser.

At the present time the flat or glass-plate condenser is used more than the Leyden jar, because by multiplying the number of plates a large condenser surface or capacity may be obtained without requiring a great deal of space



An Ultra-violet Application.

CHAPTER EIGHT.

Light.

General Action. We have seen that our various modalities operate to perform some function that is required in the bodily economy. These actions influence metabolism and growth. They are either chemical, mechanical or thermal. Thus, the galvanic current is chemical, the sinusoidal mechanical, the high frequency principally thermal.

Now we come to the consideration of light, both that of the visible spectrum, which we call the radiant or therapeutic light, and that beyond the visible spectrum, called the ultra-violet.

Visible light has two functions: it is both thermal and chemical; ultra-violet is chemical only.

The sun is our great biochemist and the pivot on which Nature's great cycles revolve. Light, heat, radiant energy. From the various lamps utilized for treatment purposes we may avail ourselves of the therapeutic value of the attributes of both the visible and invisible waves.

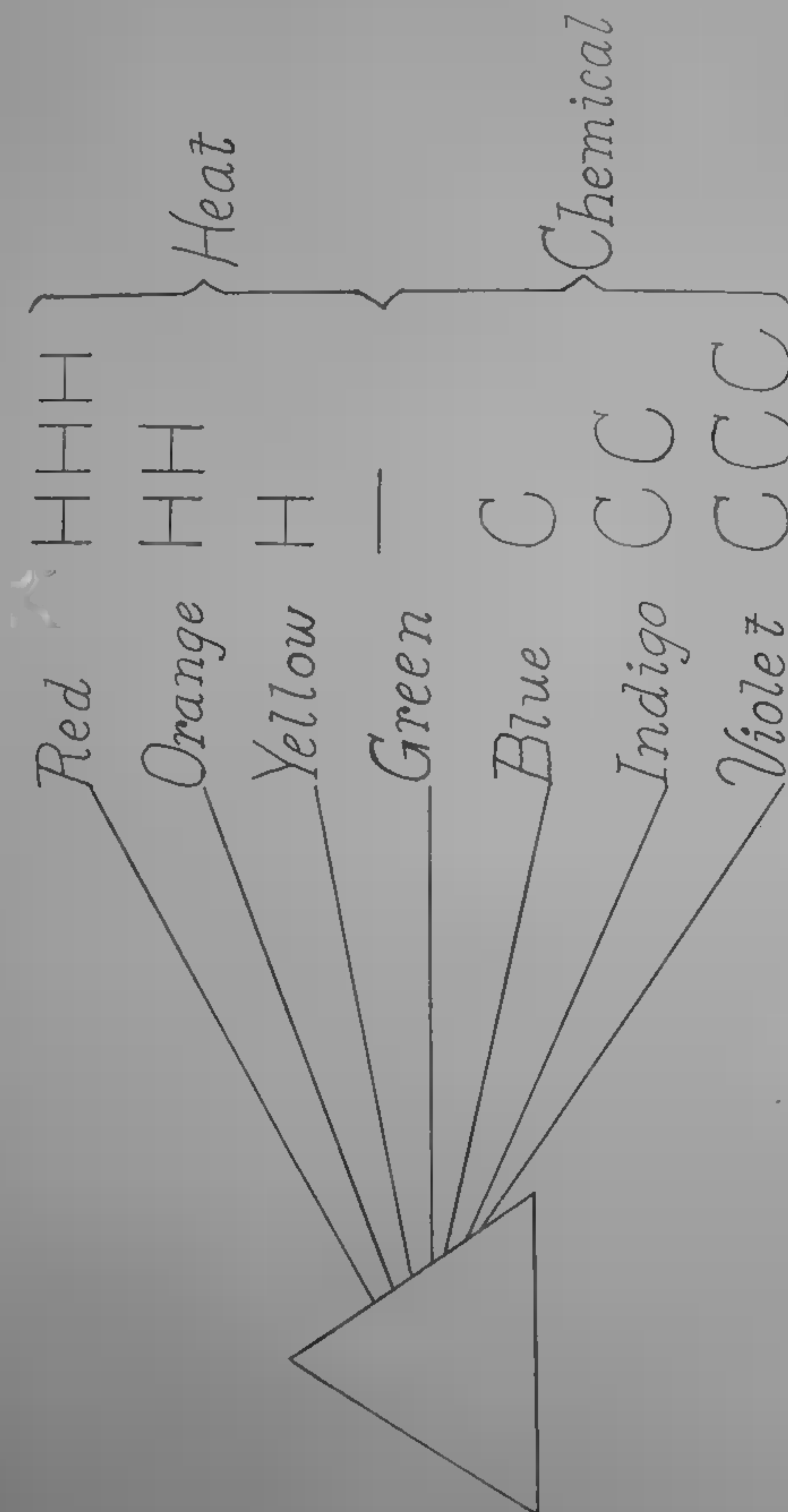


Fig. 23—Showing Heat and Chemical Areas in Light.

The Visible Spectrum and the Physiotherapeutic Spectrum. If we pass the beam of white light through a prism we find it split up into the seven colors of the visible spectrum: red, orange, yellow, green, blue, indigo and violet. (Fig. 23). The red has the longest wave-lengths and the slowest rate of vibration. The waves shorten and the rate increases as we go toward the violet end of the spectrum.

The greatest amount of heat is in the red rays. In the illustration we indicate the degree of heat by three H's for the red, two for the orange and one for the yellow. It is essentially absent in the green. There are no chemical properties in this part of the spectrum. That is why we use the red or orange light in the photographic dark-room, because there are no chemical rays to injure the plates.

The chemical portion may be represented by one C for the blue, two for the indigo and three for the violet.

Green we observe is a neutral color, placed in the middle and flanked by the heat rays on one side and the chemical rays on the other, both being essentially negligible in the green itself.

This, in my mind, is one of the reasons why green is the universal color of Nature. The other is that the chlorophyl of the green leaf is "able to separate oxygen atoms from the carbon and hydrogen atoms in the mole-

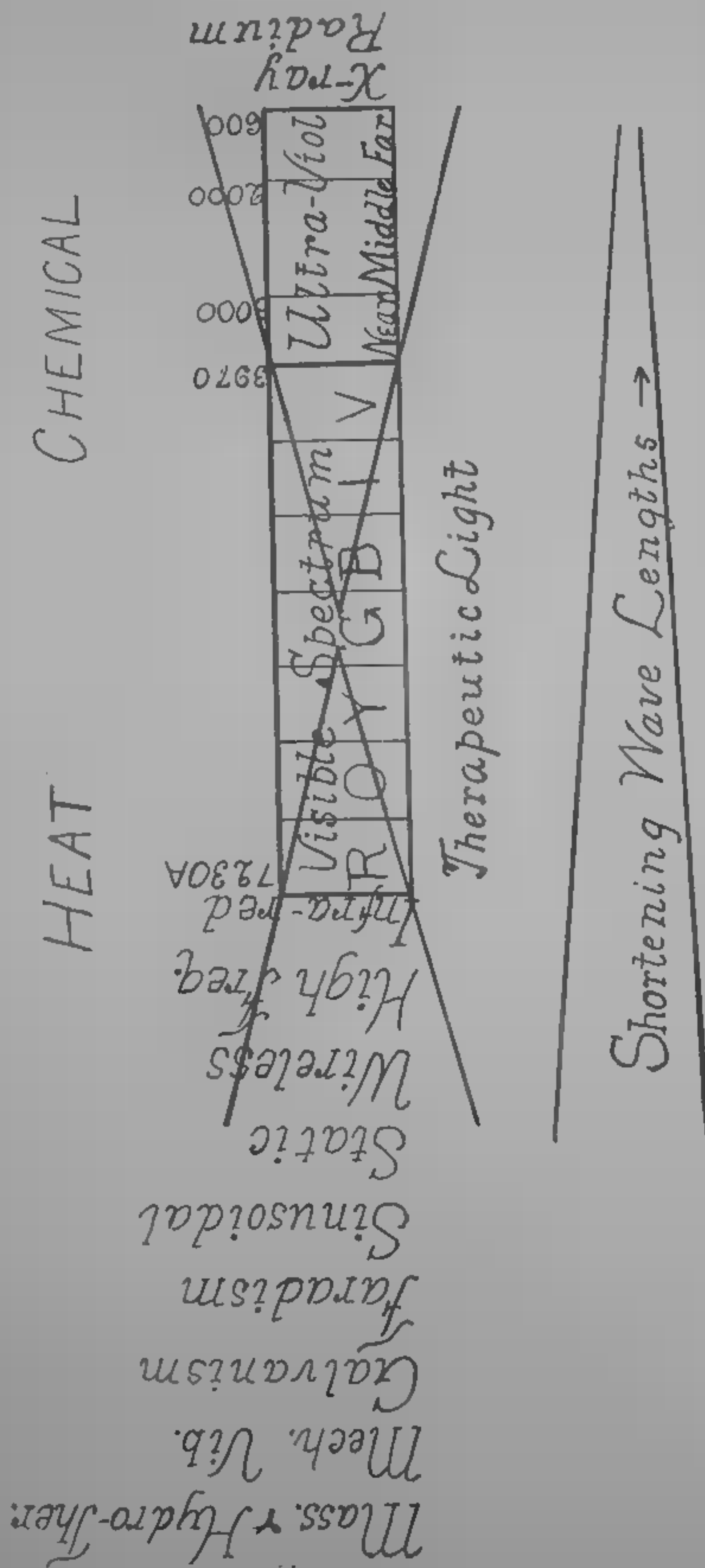


Fig. 24—The Visible and Physiotherapy Spectrum.

cules of carbon dioxide and water, storing the carbon in their cells, and by the aid of sunlight setting free some of the oxygen and building the carbon and other atoms into starch, sugar, gums, lignum and cellulose."

If we indicate the heat portion of the spectrum we may diagrammatically illustrate it by a wedge resting in the green and broadening out to its maximum in the red. If we pass below the red we have invisible rays, known as the **infra-red** which are **pure heat rays**. Infra means below.

Another wedge passing from the green to the violet indicates the increasing volume of chemical rays. Ultra means beyond and if we pass to the invisible waves beyond the violet we have the **ultra-violet** which are **pure chemical rays**.

Beyond the ultra-violet are found the X-rays and the gamma rays of radium.

The visible spectrum covers the field of the white light. Below the infra-red we have the high frequency and the wireless. All of this is directly in line with the actual wave lengths and in general the longer the waves the greater their penetration. This decreases as the waves shorten on through the ultra-violet. The X-rays and radium lie far beyond the ultra-violet and here penetration increases. It is probable that they travel through much as do streams of electrons.

Now, schematically below the high frequency we may place the static, sinusoidal, faradic and galvanic currents, mechanical vibration, massage and hydrotherapy thus completing what I call the **physiotherapeutic spectrum**. (Fig. 24).

Therapeutic Properties of Radiant Light. The radiant or therapeutic light has all of the therapeutic properties of heat and chemical rays possessed by visible light. If the source be a carbon light not surrounded by glass, there are also some invisible or ultra-violet rays given off, but these are stopped by the glass of the incandescent lamp.

This latter is usually employed in the form of a 1500 watt bulb and has been used for the greater part, for its heat effects. This calls for an average exposure of 20 minutes. The heat rays being longer are immediately and distinctly felt. If the chemical effect of white light is desired a long exposure is necessary because of the comparatively small volume of chemical rays. However, those that are there have a greater penetration than the ultra-violet, a fact which ordinarily is overlooked and which means much if they are employed in conjunction with the ultra-violet, where greater penetration is desired.

If you step out into the sunshine the first effect you feel is that of heat; it takes sometime before tanning or



Infra red Generator, Large Element.

blistering or chemical effects take place. This is your guide for the employment of the therapeutic lamp.

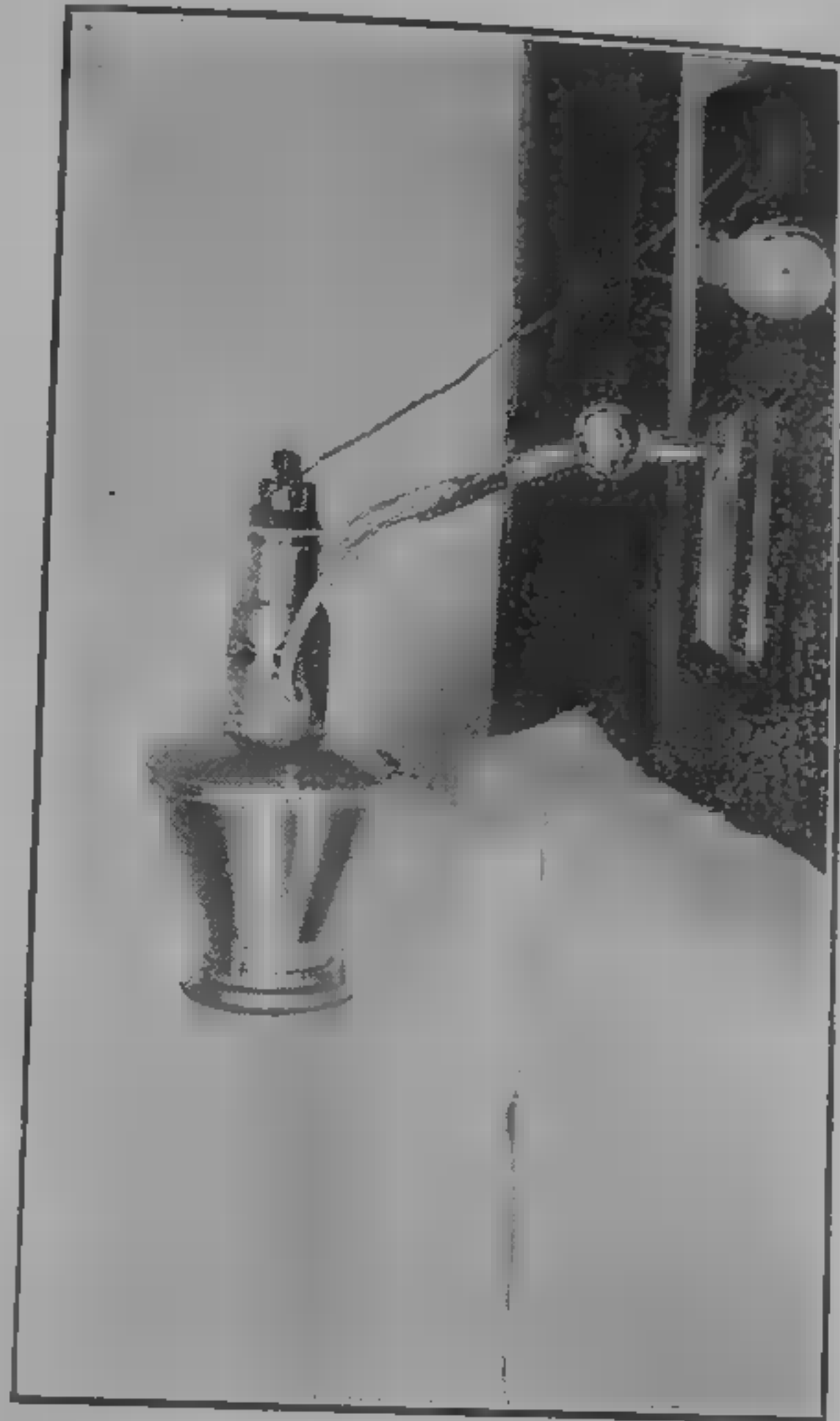
Units of Measurement. The first unit employed in



Galvanic Generator.

measuring light waves was the **micron**, the abbreviation for which is the Greek letter " μ ". The micron is one one-thousandth of a millimeter. This again has been divided

into one thousand parts, forming a unit known as the millimicron, represented by the double ($\mu\mu$) and which is one-millionth of a millimeter. The other popular unit



Desk Type Heat Lamp.

is the Angstrom. Its abbreviation is the capital A and there are 10 A in one millimicron, consequently the Angstrom is one ten-millionth of a millimeter.

General Application. A ten to twenty minute application is used ordinarily before the use of the air-cooled quartz lamp, by leading physiotherapists. A twenty-

minute or longer exposure is beneficial for the relief of pain. Long treatments up to one hour are employed for the chemical effect, in infections, etc.

Contra-indications. Where used to obtain the heat effect it is not advisable to use over large areas having confined pus. Usually not advised before quartz lamp in pulmonary tuberculosis. Should not be employed immediately after a hearty meal.

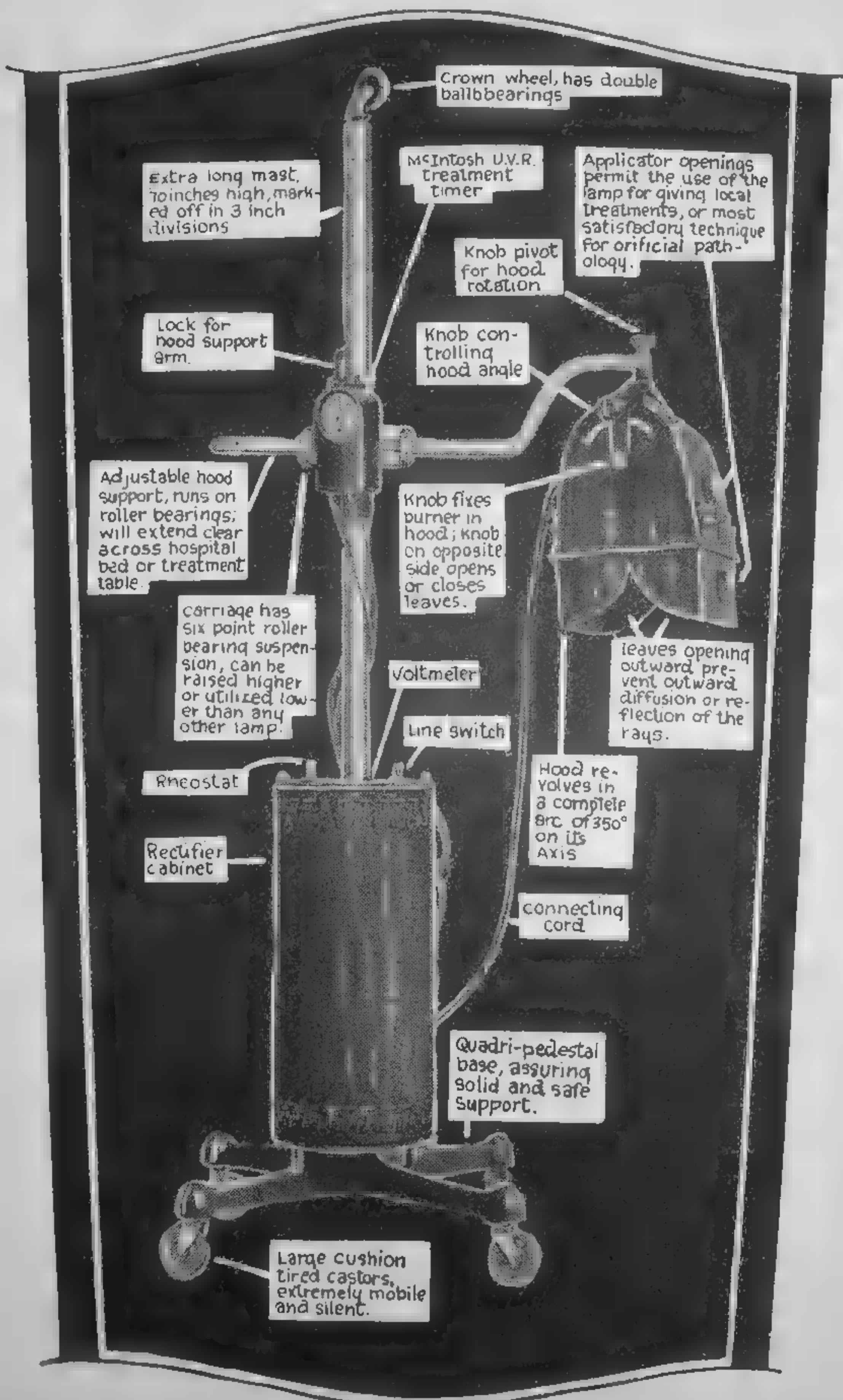
CHAPTER NINE.

Ultra-Violet Rays.

General Range of Visible Light and Ultra-Violet is given herewith in Angstrom units:

Red	7230 to 6470
Orange	6470 to 5850
Yellow	5850 to 5750
Green	5750 to 4920
Blue	4920 to 4550
Indigo	4550 to 4240
Violet	4240 to 3970
Ultra-Violet	3970 to 600

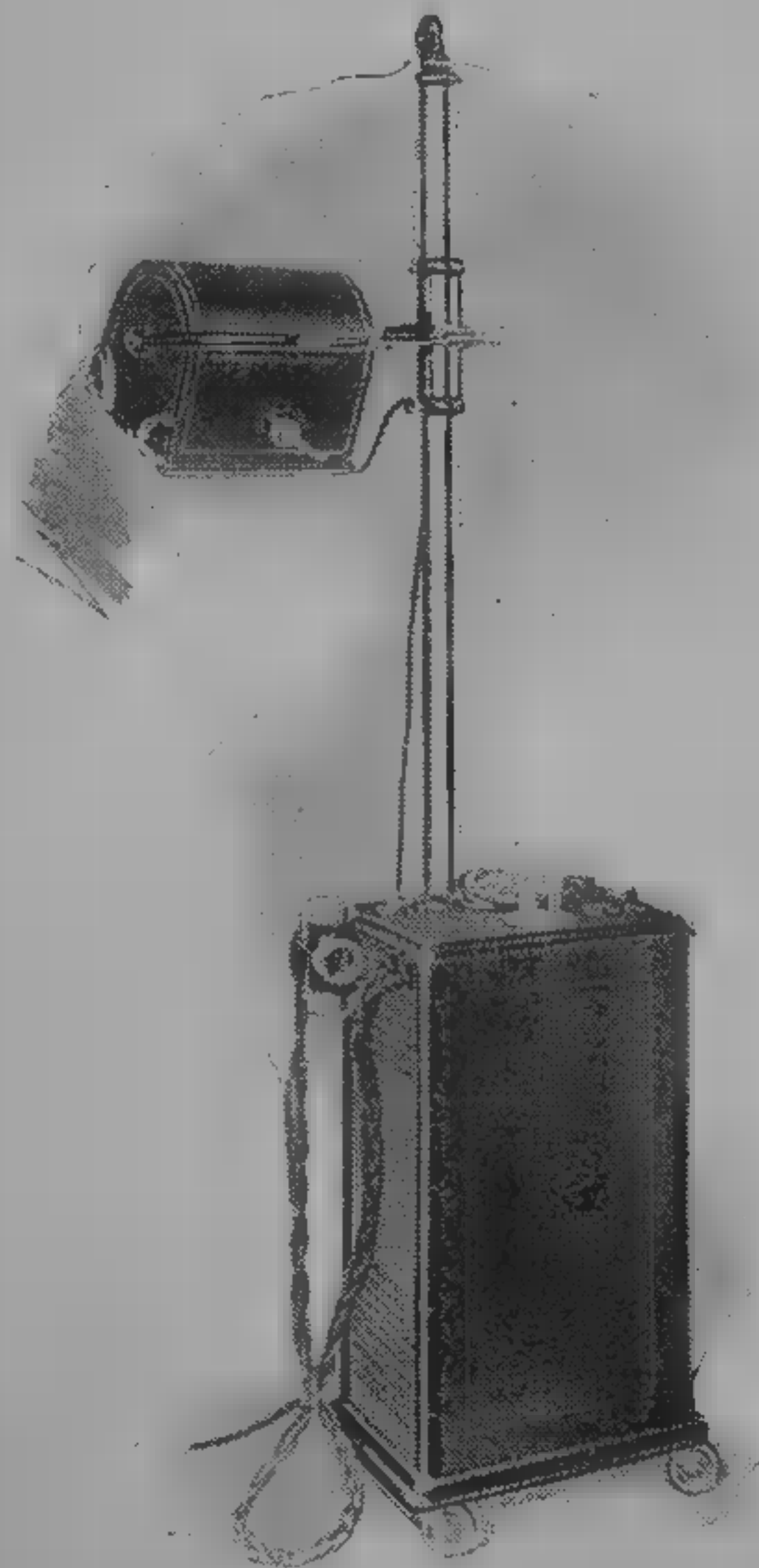
The near ultra-violet covers from 3970 to 3000; the middle ultra-violet, 3000 to 2000; and the far from 2000 down; the limit which quartz transmits being about 1850. Luckiesh makes only two fields, the near and the far with 3000 as the dividing line. Pacini found the bands which had the greatest favorable effect (biological) on metabolism were 3022, 2967, 2925 and 2894, while the most powerful germicidal band was 2536.



McIntosh Model Alpine Sun Lamp which may be used for both long and short rays.







Victor Combined Air and Water-cooled Quartz Lamp with Self-contained Cooling Device.

Air and Water-cooled Lamps Have Identical Spectra.

For years I have believed and taught that the air-cooled lamp gave ultra-violet down to 2100 Angström units and the water-cooled from about 3500 A. down to 1849 or the limit of quartz transmission. Recently it has been definitely shown that the spectra produced by the two lamps are identical and the same field of ultra-violet may be covered by either lamp.

The reason for employing the air-cooled lamp for general irradiation and for larger surfaces and the water-cooled for small areas and orificial work and wherever the short rays are desired is essentially a matter of convenience, it being easier to get the small water-cooled burner in close proximity to the tissues or to use it about the orifices, while larger surfaces are more conveniently radiated and with a greater volume of long rays with the air-cooled lamp.

A recent arrangement giving great adjustability to the air-cooled burner has to a considerable degree made this form capable of covering the general range of the short rays as well as that of the longer rays where the physician does not feel that he can install both forms.

I am now making use of the terms long ultra-violet and short ultra-violet in preference to saying air- or water-cooled.

If an ultra-violet generator is placed at a distance of

forty inches, all of the short or destructive rays will be prevented from reaching the skin being unable to penetrate that distance through the air, consequently in using a burner at thirty to thirty-six or forty inches distance only the long or up-building rays will be used.

If the burner is placed close to the area treated then the short bactericidal rays will be those which will preponderate in their action.

Why Long Rays Regenerate and Short Destroy. The long rays have greater penetration and pass through the protoplasm of the cell to reach and stimulate the nucleus and cause cell regeneration. The short rays are stopped by the protoplasm, produce coagulation, cut off nutrition to the nucleus and result in destruction of the cell. Thus the long rays are biological, and regenerative; the short destructive, abiotic, bactericidal.

The Long Rays. The out-standing feature of the long rays is their great influence in increasing the blood-calcium index. It is this fact which makes them valuable in so many diseases where we have calcium deficiency, as in tuberculosis, rickets, skin diseases, asthma, hay fever, rapidly growing malignancies, etc.

The long ultra-violet rays to a very definite degree, favorably influence the metabolism of phosphorus and iron but not to as great a degree as they do calcium. They also build up general bodily resistance. There seems to

be some difference of opinion concerning the penetration of the long rays. It is claimed usually to be about one millimeter except when there is pressure on the tissues



A Tonic Treatment.

to drive out the blood when it is said to be a little more than four millimeters.

The Short Rays. The short or bactericidal rays are so

powerful in their germicidal action that where they can be brought within direct contact it is a matter of from ten to twenty-eight seconds only for destruction of the bacteria to occur.

We are handicapped in the employment of these rays by their very slight penetration. If these short rays possessed the penetration of the long infra-red rays, it would be seen that theoretically we might eradicate all bacteria within a given area in a single treatment. This would be limited though by destruction of normal cells as well, but there is presented here a problem which I have given thought to for some time and which will be solved some day; that is the super-imposing of the short ultra-violet on longer and more penetrating wave lengths to make their use feasible in deeper-seated infections.

At present we use short rays locally where we can contact or reach the infection for their local germicidal action and at the same time give general irradiation with the long rays, to increase systemic resistance.

An Overdose of Ultra-violet Possible. In the earlier use of the long ultra-violet rays we were in the habit of starting with an exposure of each area of about 2 or 3 minutes at 30 or 36 inches, increasing one minute at each succeeding exposure until we frequently ran the time up to 30 or 40 minutes and often brought the burner closer to the skin because we found as pigmentation took place,

we did not get the blistering from close range that would have resulted had we started with the generator close to the skin.

The reason for this is that the ultra-violet produces deposits or granules of melanin in the skin and these fluoresce under the influence of the ultra-violet and give off secondary ultra-violet rays.

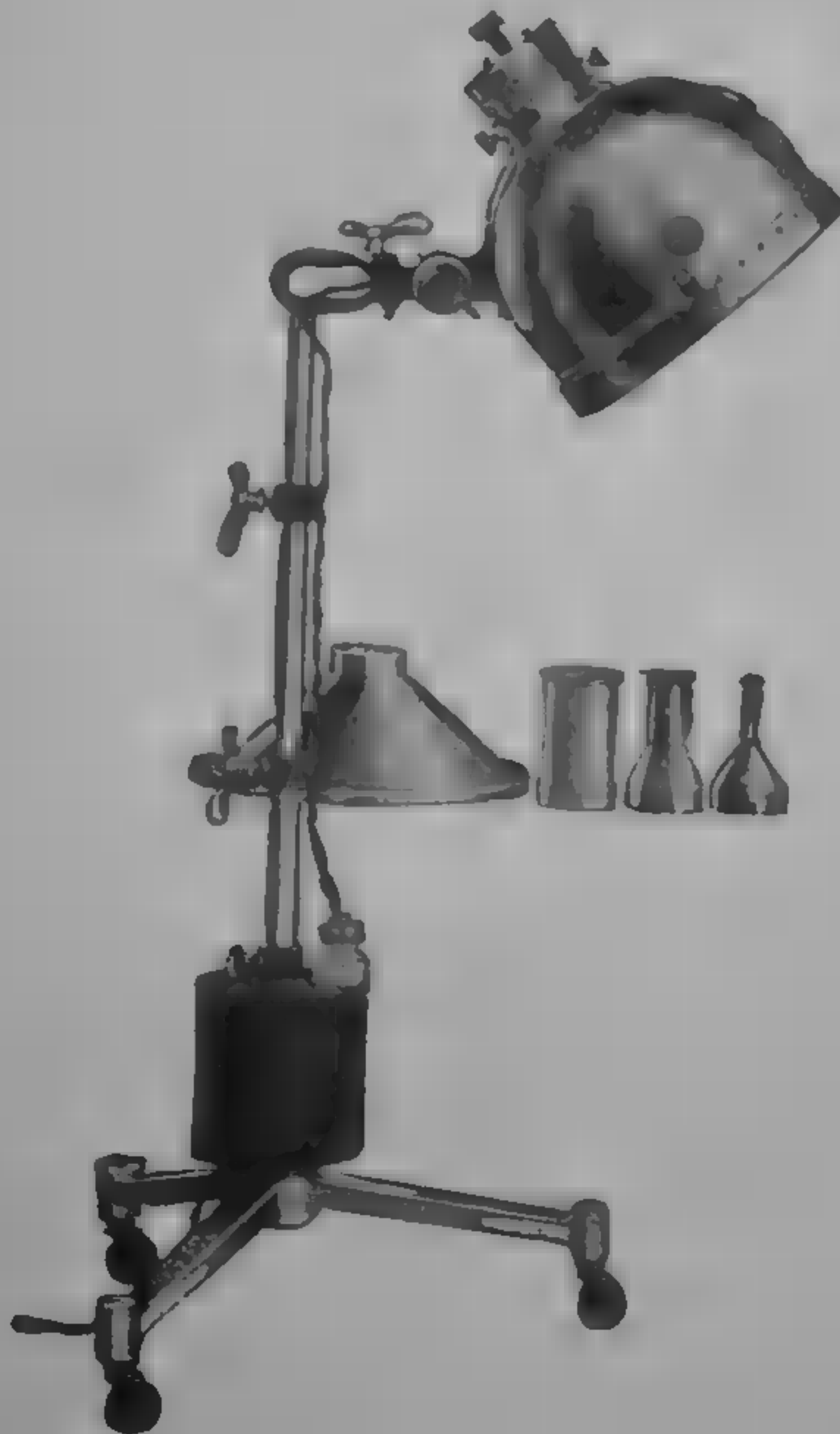
According to Stokes' law, the secondary rays when fluorescence is produced are always longer than the primary rays so that the short destructive ultra-violet rays are lengthened out into the harmless long rays.

All operators who have had any considerable experience with the earlier technique will recall many cases that were progressing satisfactorily under the technique, suddenly take a turn in the other direction and apparently be made worse by each treatment. I was at a loss to account for this in my earlier experience but fortunately did what was the best thing to do; stopped the treatment for some time and when I resumed, started with the short treatment and gradually built up again.

More clever men have worked out the reason for this as showing that an over-dose of ultra-violet is possible. Really an over-sensitization as with an over-dose of a vaccine (anaphylaxis).

Consideration of this has brought about a radical change in technique so that at the present time in the

use of the new "step-ladder" technique, no longer than five or six minutes is employed over any single area with an active or new burner or up to ten or fifteen minutes with an older or less efficient burner.



Carbon Arc Ultra-violet Lamp.



Universal Combined Ultra-violet and Therapeutic Light with Rays
Directed to the Vagina.

Also Rollier believes in starting with only a small area of the skin, (the rays from knees down, the first time, hip to knees added at second treatment), thus avoiding trouble in those over-sensitive to the chemical stimulation of the ultra-violet.

I believe we will ultimately come to dosage directly based on the number of square inches of skin exposed, just as we use diathermy with so many milliamperes to one square inch, and further standardized in accordance with the emission volume of the burner.

The New Technique. The older method which has been employed for many years consisted in starting with an exposure of about two minutes at thirty inches and then increasing the time one minute on each succeeding exposure, often shortening the distance as tanning occurred. The exposures were not infrequently run up to thirty or forty minutes.

The new "step-ladder" technique consists in starting at thirty inches with an exposure of only thirty to sixty seconds with a new and active burner and giving the same dose for three successive treatments, then increasing one half minute in time every third treatment until a maximum of five or six minutes is reached, and no more than this at any succeeding time. If an old and inactive burner is used start with even shorter exposures.

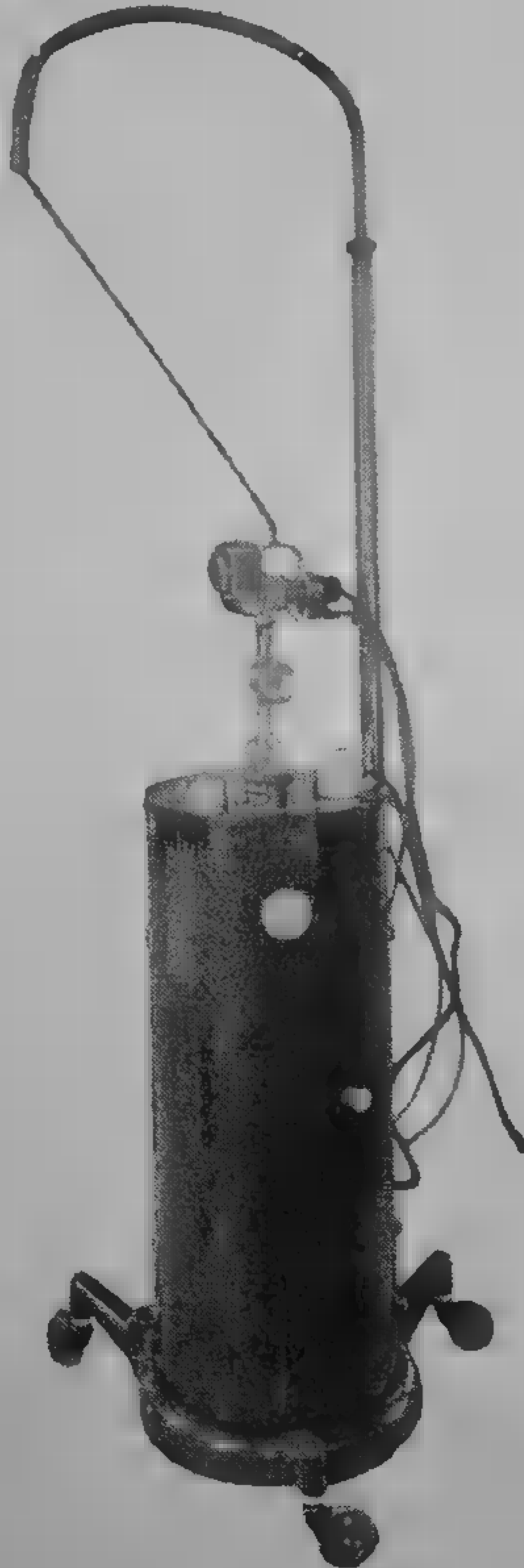


Fig. 28—Kromeyer Water-cooled Lamp, Self-contained Unit.

increase one minute every third treatment up to ten or fifteen minutes.

You may standardize your individual burner and find out just how long an exposure it requires to produce a certain reaction and thus be able to use it accordingly. Here is a simple method.

Cut three small holes, say $1\frac{1}{2}$ inches in diameter, in a piece of cardboard. Place your lamp at say 30 to 36 inches and expose one-half minute with only one hole uncovered; then another half minute with two open and finally a third half-minute with all three holes uncovered.

By this hole No. 1 will have had $1\frac{1}{2}$ minutes exposure, No. 2 one minute and No. 3 half a minute.

The comparative effect on the skin is observed and your lamp used in accordance or if no area shows an erythema, find a dose that will. Erythemas appear in from 4 to 6 hours after the application.

The redness is usually classified according to its intensity as 1: A mild or **stimulative erythema**, which quickly disappears. There is little effect on the protoplasm of the cells, but the capillaries are distended. Requires about half a minute at 30 inches for first exposure.

2. **Regenerative erythema** which is a marked redness and decided hyperemia, in fact a reaction just short of vesication or blistering. Requires about one minute at 20 inches, or 2 to 3 minutes at 30 inches. Used in skin



Fig. 29—Alpine Sun Lamp for Alternating Current.

diseases and in infections involving tonsils, mucous membranes, etc.

3. **Destructive erythema.** A reaction accompanied by definite serous exudate and blistering. The air-cooled lamp about 1 minute at 10 inches.

It is almost a universal practice with most operators to precede general systemic irradiation with a ten to twenty-minute exposure to the radiant or therapeutic lamp.

The water-cooled lamp is employed usually within a distance of three to six inches from the surface. An initial exposure of a quarter of a minute at three inches ordinarily will produce a stimulative erythema; one-half minute for the regenerative and one minute for the destructive.

Miscellaneous Suggestions. The intensity of the ultra-violet varies inversely with the distance; e. g. twice as far, one-fourth as strong. When solid quartz applicators are used their length does not affect the strength of the rays as they are carried through in full strength, but if a hollow cylinder with a quartz terminal is used, the length of the cylinder correspondingly affects the intensity of the rays.

Parts that are not ordinarily exposed to light are more sensitive. Brunettes require about 10% more exposure than blondes.



Photo Therapy Lamp.



A Convenient Type

No scarring ever follows non-contacted exposures. Severe blistering, with systemic reaction may follow but as only the superficial layers of the skin are affected no scars will result. A long exposure with a quartz applicator and no filter may generate sufficient local heat to occasionally produce a real burn and therefore sometimes leave a permanent scar.

A grain or two of resorcin given internally night and morning to patients who burn rather than pigment, will overcome this tendency and normal pigmentation will result.

Where a generally toxic condition exists, general radiation is contra-indicated because ultra-violet possesses an autolytic action and an already overtaxed system is subjected to an additional strain or effort.

Sponging the surface irradiated with alcohol will increase the effect of ultra-violet.

Remember that increase in calcium, etc., may be produced without any visible erythema occurring. A test of this will be convincing to those who balk at the short, "step-ladder" technique because it appears to be insufficient to obtain results.

Carbon Arc Lamps. The ultra-violet obtained from the carbon arc is claimed to be more like that of sunlight, and to cover the whole field down to the disappearance

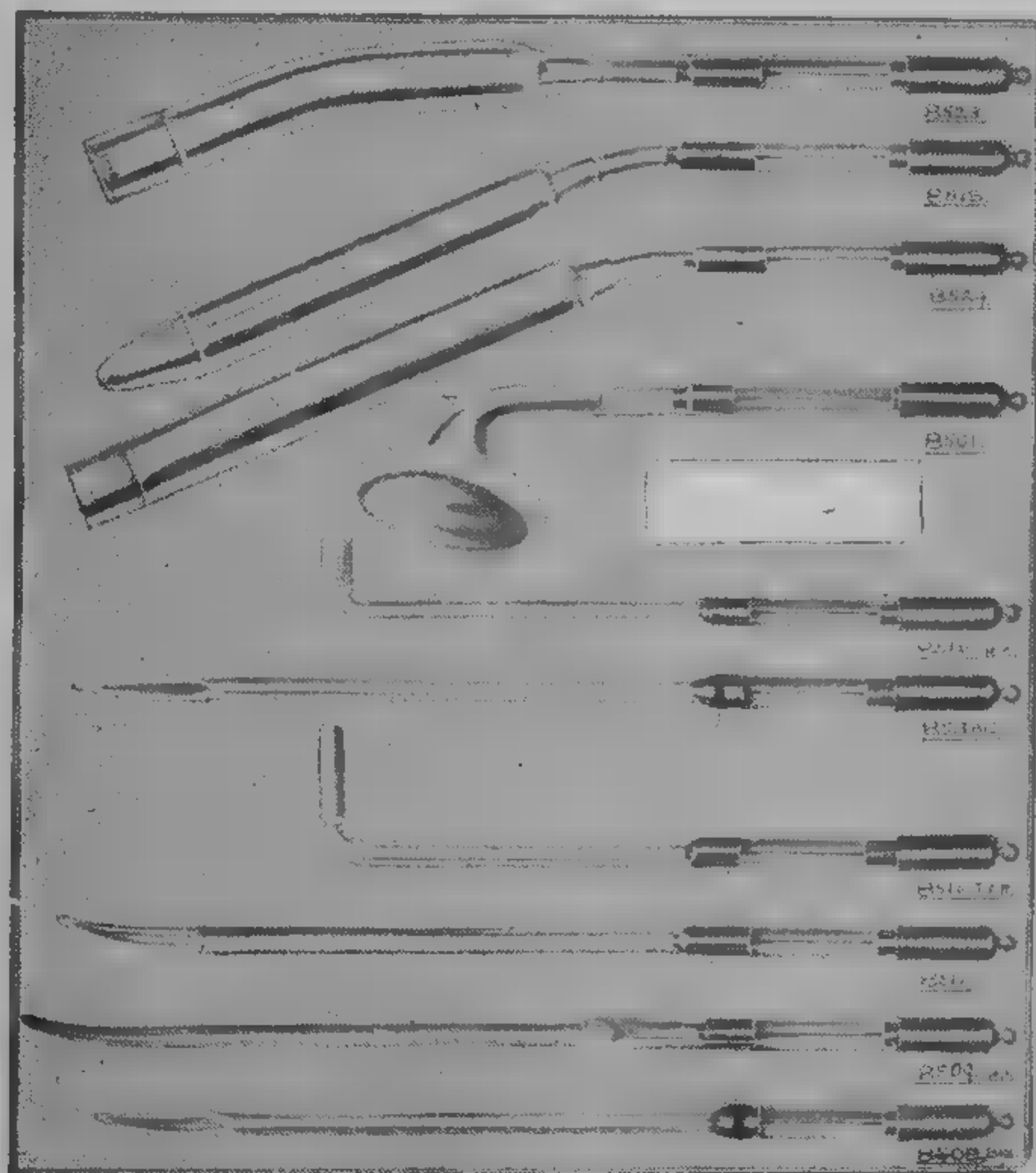
of ultra-violet. These lamps have been improved greatly in the last two years to possess increased wattage and therefore greater power and are quite popular at the present time. They produce a lesser quantity of ultra-violet than the quartz burners and call for relatively longer exposures. They may be standardized in the same manner as the quartz-burners by clinical test. It is claimed that special forms of carbon will make available the desired form of ultra-violet, regenerative, bactericidal or cellulicidal.

Quartz-mercury High Frequency Electrodes. These high frequency electrodes, being made of quartz and also containing mercury, give at one and the same time, high frequency and ultra-violet. These electrodes are used from the terminal of the secondary Tesla or from the Oudin, just as ordinary high frequency electrodes are employed. They are available for orificial treatments and in a surface electrode for skin diseases.

The increased circulation from the high frequency lessens the reaction from the short ultra-violet rays which are being utilized.

In many instances 3 minutes seems to be a suitable dosage in time, but some have found a longer treatment, up to 7 or 8 minutes possible. Advisable to test out with shorter dose in the beginning.

Suggestive Technique for Various Diseases. Acne. Produce a medium or regenerative erythema with either air-cooled or water-cooled lamp to the point of mild



Quartz Mercury High Frequency Electrodes.

desquamation. Best used in conjunction with indirect Tesla sparks.

Alopecia. Air-cooled lamp to produce a destructive erythema. Blistering necessary. Repeat after desquamation has taken place.

Anemia. General mild (stimulative) radiation to entire body. Best preceded by 1500-watt therapeutic lamp for ten or twenty minutes.

Bunions. Water-cooled lamp. Use pressure. Start with about 15 or 20 seconds and gradually increase time at succeeding treatments up to about 3 or 4 minutes.

Carbuncles and Boils. To abort use water-cooled lamp with pressure, for about three minutes. When too far advanced to abort, use long exposure with radiant light and then apply the water-cooled lamp three minutes. Nick the top with bistoury to lessen tension and external resistance, and thus circumscribe the area. Fulguration or coagulation superior to the lamp.

Gastric Ulcers. Deep therapy lamp to entire abdomen followed by air-cooled lamp. (Stimulative erythema). This will also decrease hyper-acidity.

In addition localize over an abdominal area 6 inches in diameter above the ulcer and produce a second degree erythema.

Gynecological Conditions. Water-cooled lamp with special applicator used for cervicitis, gonorrhea, pruritus, dysmenorrhea, simple vaginitis, etc. One-half to one and a half minute treatments, gradually increasing time at subsequent exposures.

Hay Fever. Nasal vacuum electrode with mild spark or effleuve followed by water-cooled lamp with anterior and



Fig. 31—Treating Pyorrhea or Mouth Infections with Ultra-violet Burdick Lamp.

also post-nasal quartz applicators. See chapter on Respiratory Diseases for more comprehensive technique.

Lupus vulgaris and lupus erythematosus. Destructive erythema with marked vesication by means of water-cooled lamp.

Naevus and Angioma. Marked blistering with water-cooled lamp usually used with quartz applicator under heavy pressure to dehaematize. Do not repeat until after desquamation. My experience has not been satisfactory with deep-seated naevi, nor with those port-wine marks over the bridge of the nose or where thin skin over bony areas prevents firm pressure. For these X-ray or radium is better.

Neuritis. Yields ordinarily to radiation with air-cooled lamp. (Regenerative erythema.) If some blistering should take place, the marked improvement noted with fading of reaction will well compensate patient for the temporary discomfort of the vesication. See other methods for Neuritis in Chapter Twenty-one.

Psoriasis. General stimulative raying with air-cooled lamp followed by local application of water-cooled with quartz lens and some pressure to get a destructive erythema. Repeat when reaction clears. See Chapter Thirteen for technique combining high frequency and X-ray or ultra-violet.

Pyorrhea is treated with the water-cooled lamp and quartz applicator. (Fig. 31.)

Tuberculosis. General raying with air-cooled lamp. stimulative erythema. See Chapter Nineteen.

Ulcers. Chronic or indolent ulcers give good response to light treatment. First use therapeutic light for fifteen

or twenty minutes and then water-cooled lamp about 30 seconds in close contact with ulcer, if possible. Gradually increase time at subsequent exposures up to 3 or 4 minutes. General stimulative raying with the air-cooled lamp



Fig. 32—Treatment of Varicose Ulcer with Water-cooled Quartz Lamp.

is also advised, and internally parathyroid 1/10 grain twice or three times daily. (Fig. 32.)

Remarks. The publications of various manufacturers will be found reliable guides for ultra-violet technique.

CHAPTER TEN.

Mechanical Vibration, Ozone and Thermolysis.

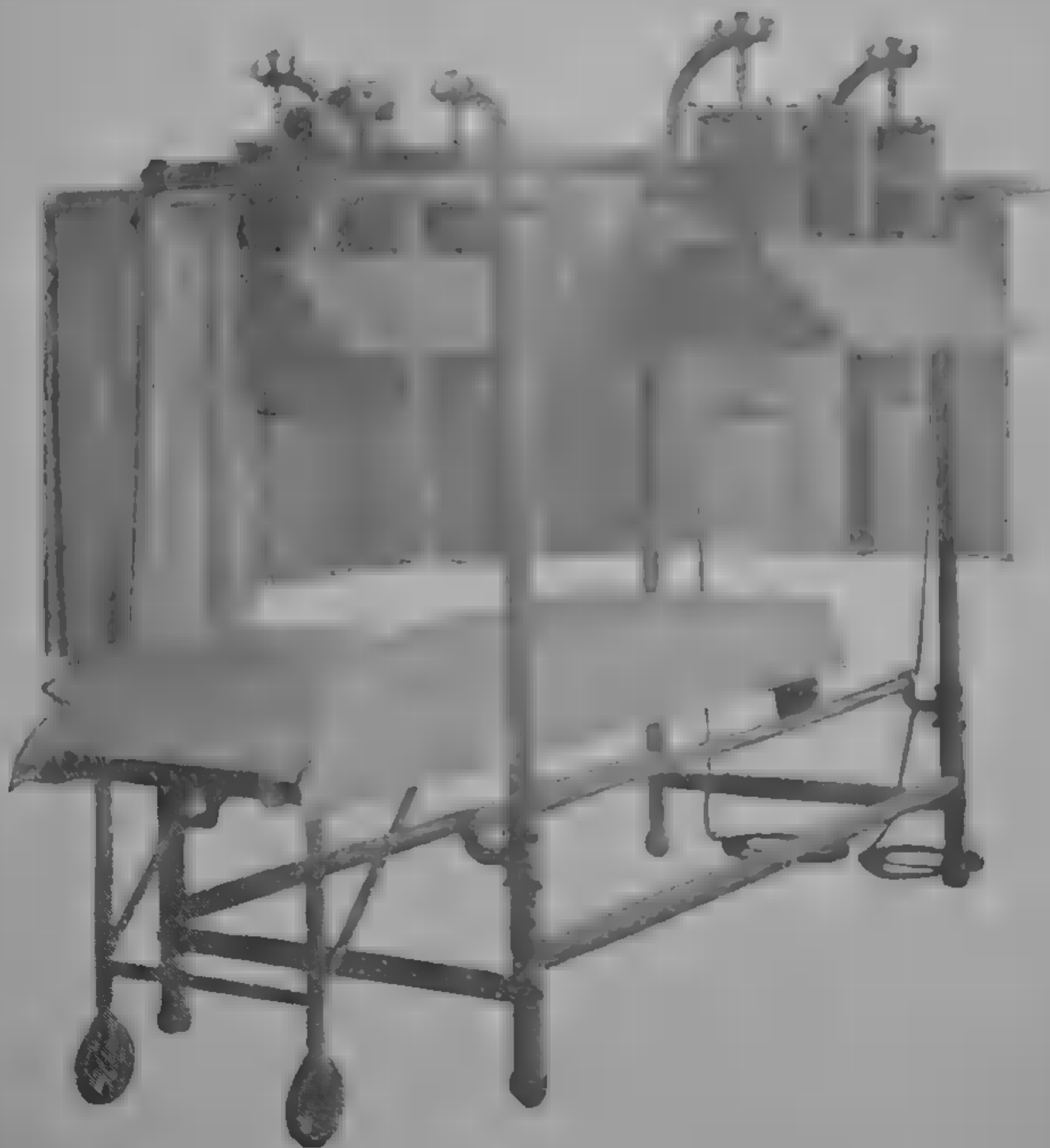
Mechanical vibration produces by its action either stimulation or inhibition. Inhibition is merely over-stimulation.

A mild or short application stimulates, a heavy or prolonged one inhibits.

In addition the vibrator is used frequently with a stroking motion which is called vibro-massage and which patients usually find very agreeable.

There are three outstanding conditions in which I find vibration the superior of other modalities. These are:

1. Congestive headaches, where 5 to 10 minutes vibration over the painful area (usually supra-orbital) will give absolute relief.
2. Simple dysmenorrhea where complete relief is afforded by 8 to 10 minutes steady, firm vibration over the area where pain is referred.
3. For relaxing the sphincter ani, which calls for 3 to 6 minutes of inhibitive vibration and will be found



Solar Arc Lamp Equipment.



Attractive Looking Diathermy Apparatus.

valuable in enabling one to painlessly insert instruments, or replace strangulated or thrombotic hemorrhoids, etc.

Oscillators, vibrating chairs, etc., are useful forms of vibration.

The original theory of vibration was the stimulation or inhibition of spinal centers. The interested reader is referred to my "Guide to Vibratory Technique" for further data.

Ozone. Whenever an electric spark passes through the air, ozone is liberated. Ozone is known under the chemical symbol O_3 and is an allotropic form of oxygen. At the same time that ozone is liberated, nitrous and nitric oxides are also produced. The less the perceptible spark accompanying the production of ozone, the less the amount of these objectionable oxides. In administering ozone, it is necessary by filtration or otherwise to dispose of these gases.

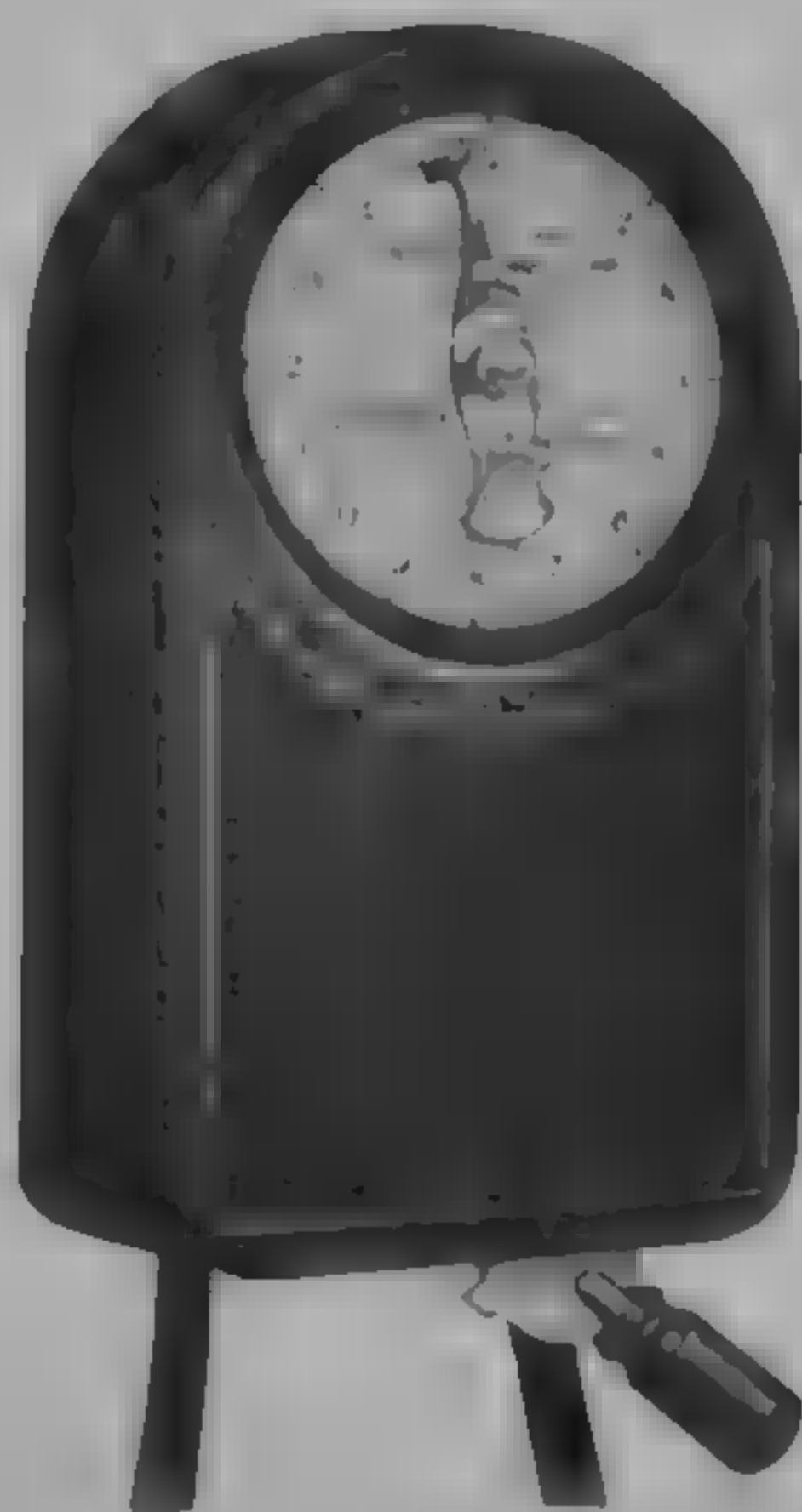
Physiological action. Ozone increases the oxygenation of the blood and tissues, increasing oxyhemoglobin and also increasing the number of red blood corpuscles. It is claimed that a decrease in white corpuscles is produced if they are above normal. In strongly concentrated form, ozone is destructive in its effect on mucous membranes and even to life itself. Germs are destroyed by it and it has been shown capable of so thoroughly disinfecting sewage that the filtered water was pronounced

suitable for drinking purposes. It is distinctly deodorant and even a small ozonizer running in a room will quickly destroy the most objectionable odors.

Indications. In one sense of the word, since oxygen is so essential, it might easily be claimed that ozone was indicated in any bodily ailment, and I am of the opinion that its inhalation would be beneficial to the extent that pure air would be desirable, but there are some diseases in which it is of particular benefit. Among these are anemia, all diseases of the respiratory organs, including tuberculosis, infectious diseases, and all conditions where there is imperfect oxidization and impaired nutrition. An ozone spray has been demonstrated to be healing in all forms of ulcers.

Thermolysis. A method of using the diathermic current for the removal of superfluous hair was devised a few years ago, to which the term thermolysis has been given. In electrolysis, the hair follicle is cauterized and destroyed by the production of caustic soda through the action of the negative pole of the galvanic current. In thermolysis, we have coagulation of the follicle by the bi-polar method. It requires a machine constructed with a special d'Arsonval or diathermic current in which the spark-gap can be adjusted so finely that there is scarcely any perceptible spark. The usual platinum electrolysis needle is employed and introduced into the hair follicle,

the patient holding a long metal handle attached to the other terminal. With the spark kept down, there is practically no pain. About ten seconds is required to thoroughly coagulate the follicle, when the hair is pulled out. Operators who have been accustomed to electrolysis will be bothered a little at first, as the hair is not loos-



Ultra-violet Timer which Cuts Off Current.

ened as it is with electrolysis and must be forcibly pulled out. Neither are there any hydrogen bubbles and the time is much shorter.

The Oudin current has been employed also for desiccation of the hair follicle. This would also be called thermolysis.

CHAPTER ELEVEN.

Gynecology.

Modalities Used. In treating gynecological cases, we employ the galvanic and the high frequency currents principally. Although the use of the vacuum or non-vacuum electrode in the vagina, attached to one terminal of the high frequency current, is still employed occasionally, the method has been largely superseded by the use of vaginal diathermy.

The technique for vaginal diathermy consists in the introduction into the vagina of a large metal electrode, such as the one illustrated. The cord to this electrode is attached to one pole of the d'Arsonval or diathermy current, the cord from the other terminal going to a block tin electrode about five by six inches in size, which is placed as low as possible on the abdomen. (Fig. 33.)

A small towel is put around the handle of the vaginal electrode, and the ends brought up over the block tin electrode and held in place by the same sand bag which anchors the tin electrode.

D'ARSONVAL TERMINALS

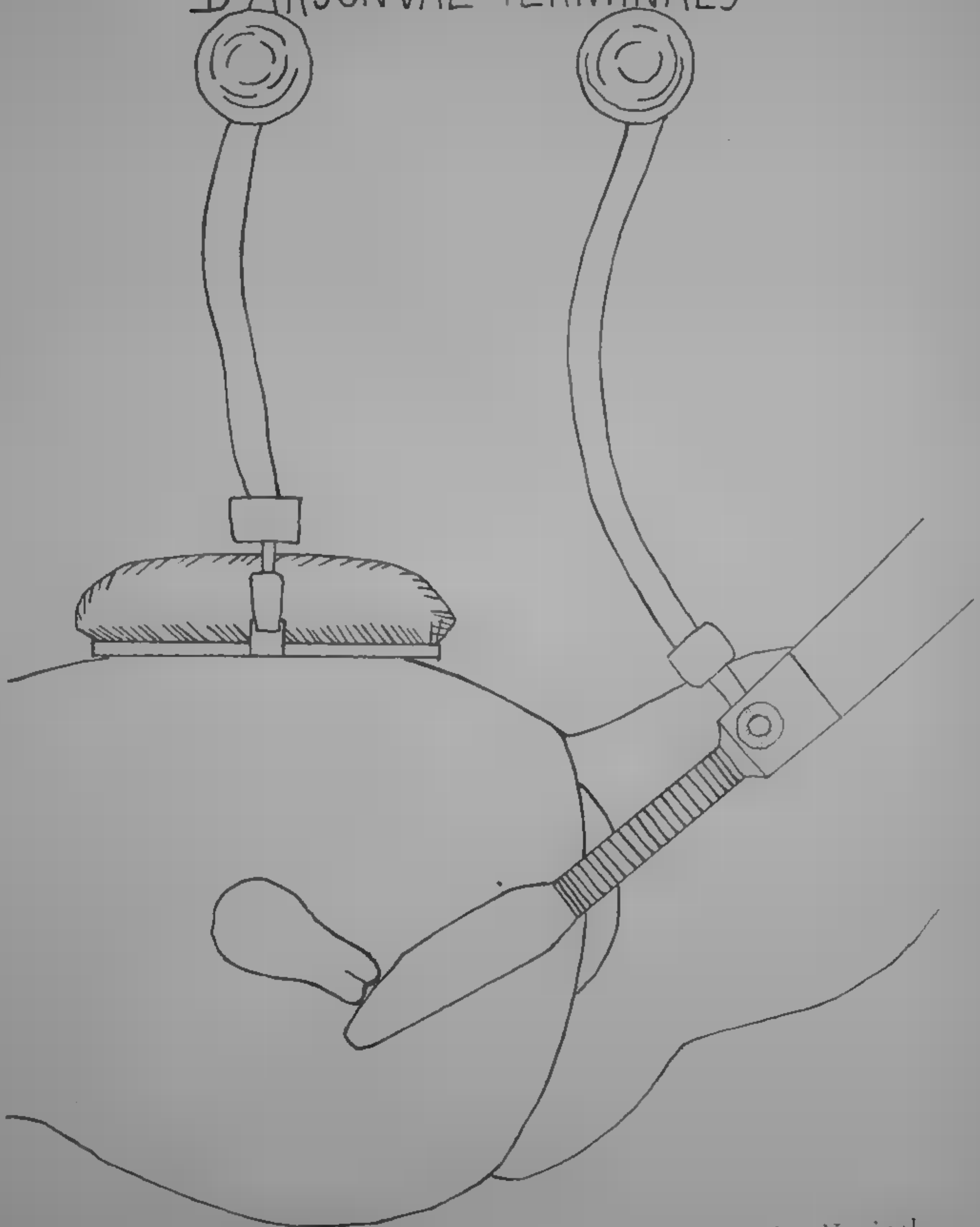


Fig. 33—Diagrammatic Illustration of Technique for Vaginal Diathermy.

I find it desirable to use a vaginal electrode of considerable size, in order that it will carry a good dose in milliamperes. The one illustrated will carry from 1000 to 1500 milliamperes without any difficulty. (Fig. 34.)

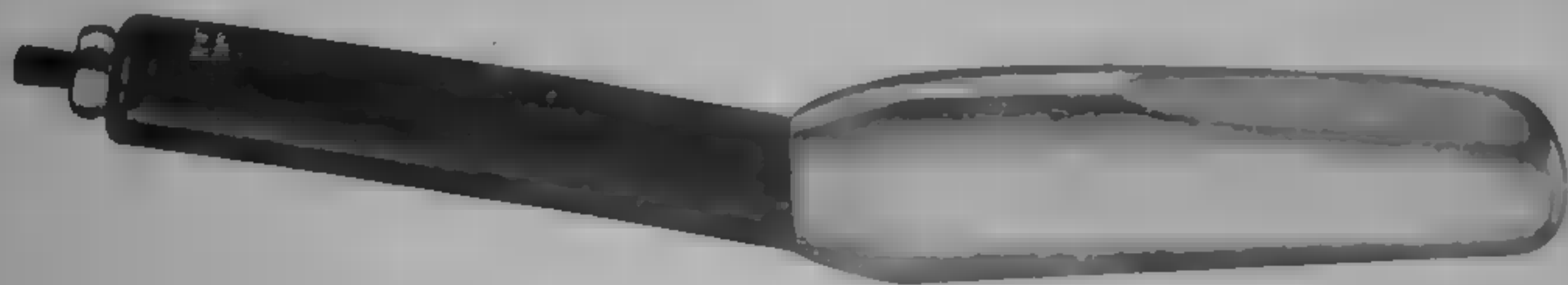


Fig. 34—Eberhart's Vaginal Electrode.

The Corbus endocervical electrodes are made to carry a thermometer, to indicate the temperature produced by the current. (Fig. 35.) This is not absolutely necessary,

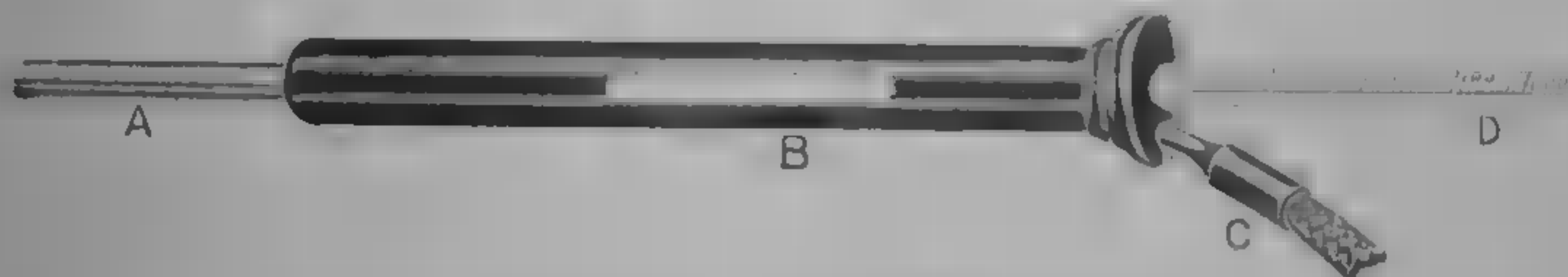


Fig. 35—Corbus Electrode.

because in cases where a large amount of heat is required, we go by the patient's toleration and give all they will stand, and we could not give any more if the thermometer did indicate the possibility; besides the thermometer inside the electrode does not give an accurate idea of the heat generated.

Diathermy may also be applied to the pelvic organs by the use of a block tin electrode over the bladder area.

and another one low down on the back, the lower one usually being the larger electrode.

Cumberbatch uses a band of mesh or block tin to encircle the body for his indifferent electrode.

The technique for the employment of galvanism varies somewhat with the different diseases, and will be given in detail with each one.

Cervicitis and Endometritis. Many of these cases respond nicely to the use of vaginal diathermy alone, but the more severe ones require the employment of galvanism, and if only one method were available, the galvanic would be preferable.

In cervicitis we have more or less enlargement of the cervix, sometimes so much so that it is as large as the fundus; with the os open and filled with a plug of very thick tenacious mucous, so ropy that often it will string out for a foot or more.

All of these cases are the final result of infection. That does not necessarily imply specific infection, although that probably will account for a very large percentage of the cases. There are plenty of other germs having their habitat on the mucous membrane, which under favorable circumstances, get a foothold and produce these inflammatory conditions.

The treatment for both cervicitis and endometritis is the use of the positive pole of the galvanic current, with

a copper or zinc electrode, in order to drive into the mucous membrane, the oxychloride of copper or zinc, for the purpose of getting at the cause of the trouble. This is copper or zinc ionization.

For years we have employed copper-tipped electrodes (see Fig. 36) which come in graduated sizes. More recently, zinc tips are made which also fit on the same



Fig. 36—Copper-tipped Electrodes for Cervicitis.

staff, because some believe that zinc is a better germicidal agent than copper.

The patient is placed on her back with the feet in the stirrups, in a comfortable position, and the ordinary metal speculum employed.

The use of metal in electrical work of this kind makes no difference unless the electrode comes in actual contact. In this case the electrode is insulated, except for the part which is introduced into the cervical canal, and therefore



Fig. 37—Diagram Showing Galvanic Technique in Cervicitis.

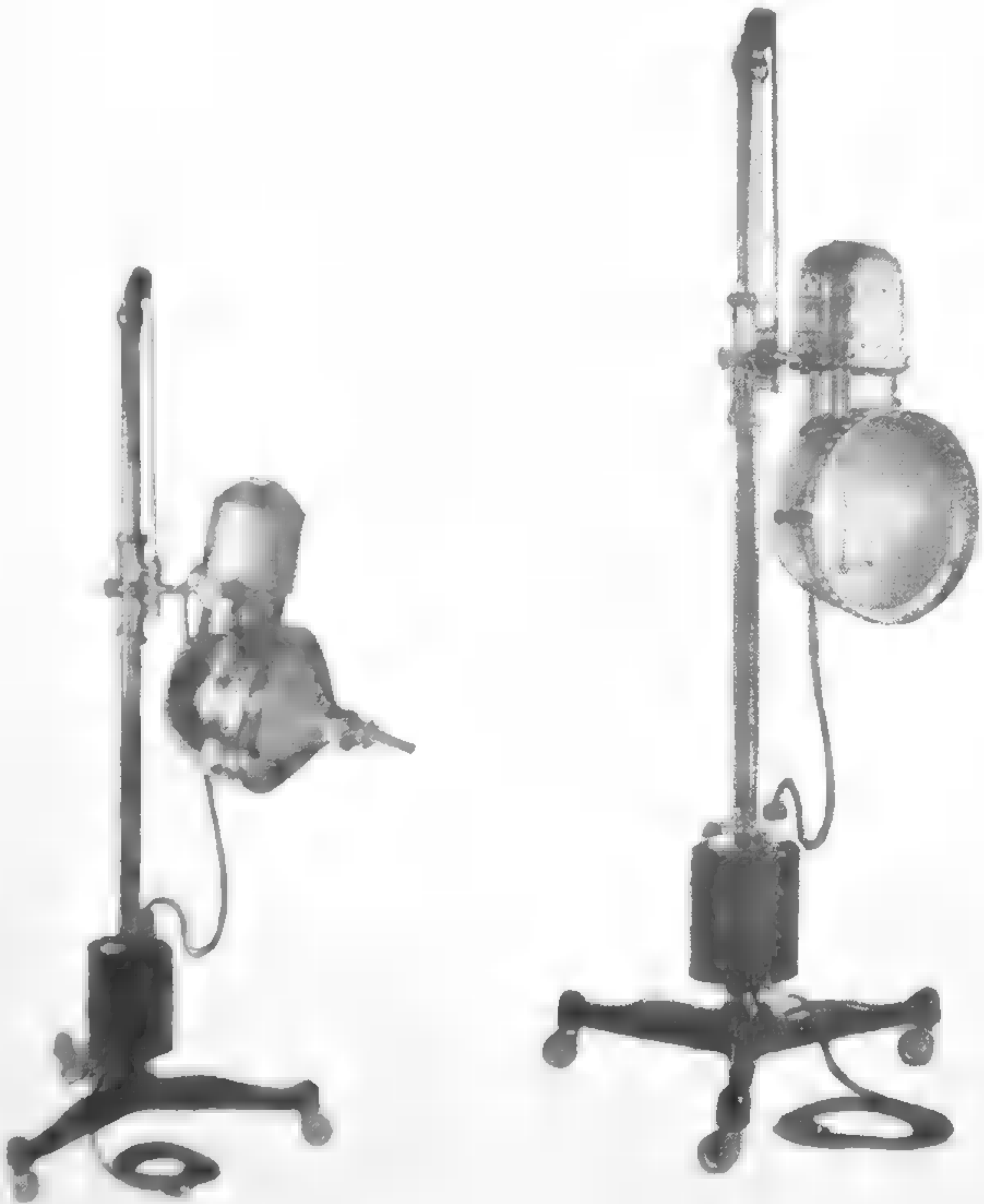
there is no possible danger of the current being communicated to the speculum.

The negative pole is a good-sized pad placed on the abdomen, after having been thoroughly soaked in hot salt solution. It is held in place with a sandbag. (Fig. 37.) The positive copper or zinc electrode is now introduced into the cervical canal, and the current slowly turned on 10, 12, 14 or more milliamperes, according to the toleration of the patient. The treatment will last 15 to 30 minutes. The current is then turned off, but when you attempt to remove the electrode, you will find that it is held fast, owing to the contracting effect of positive galvanism. Instead of forcibly pulling out the electrodes, reverse your poles, making this electrode temporarily a negative one, and turn on your current for 30 to 60 seconds or more, when the dilating and relaxing action of negative galvanism will release the electrode.

After a few treatments the drying effect of the current will reduce the discharge to a small amount. When it gets to be comparatively insignificant in quantity, it is advisable to give a few treatments, using the same electrode connected to the negative pole, to get the effect of neutralizing the acid reaction by the alkaline effect from the negative. This also liquefies the slight amount of remaining discharge, and the case is essentially cured.



Large Cabinet Diathermy Machine Giving Various High Frequency Modalities including a Cutting Current.



Carbon Arc Ultra-violet Lamps.

Where diathermy follows the galvanism, the negative application may not be necessary.

If these cases were limited solely to the cervix, this would be all that would be required. As a rule, however, the infection has already extended up into the cavity of the uterus, and the endometrium is involved. Therefore, it is necessary in order to prevent reinfection of the cervical canal, to see that the fundus of the uterus also receives the benefit of our positive galvanism on the basis that there is also an endometritis. The same electrode is used, but it is carried up into the fundus. If there is any difficulty in introducing it, employ the electrode as a negative pole which will quickly dilate and enable it to pass.

When it comes in contact with the upper part of the fundus, draw the electrode back about one-half inch, as the greatest intensity of the current seems to be at the tip of the electrode.

Now reverse the poles, so that this electrode becomes the positive, and treat 15 or 20 minutes as before, reversing if necessary, to remove the electrode. Always have current off when using pole-changer.

In conjunction, or in alternation with this method, vaginal diathermy may be employed, and in very severe cases of specific origin, diathermy may be used with a special electrode in the cervix, bearing in mind that

whenever there has been a specific infection, the temperature must be brought well above 104° Fahrenheit, and maintained for a long time. The Corbus, thermometer carrying electrodes, are very satisfactory in specific endocervicitis, but must be used cautiously as coagulation has followed their use in some cases, when thermometer reading was within normal limits.

Leucorrhea. In leucorrhea the diathermy treatment has proved satisfactory in a large number of cases.

The galvanic treatment is best given with the Neiswanger bag electrode. (Fig. 38.) This bag holds about 100 c.c. of fluid. You may use either copper or zinc sul-

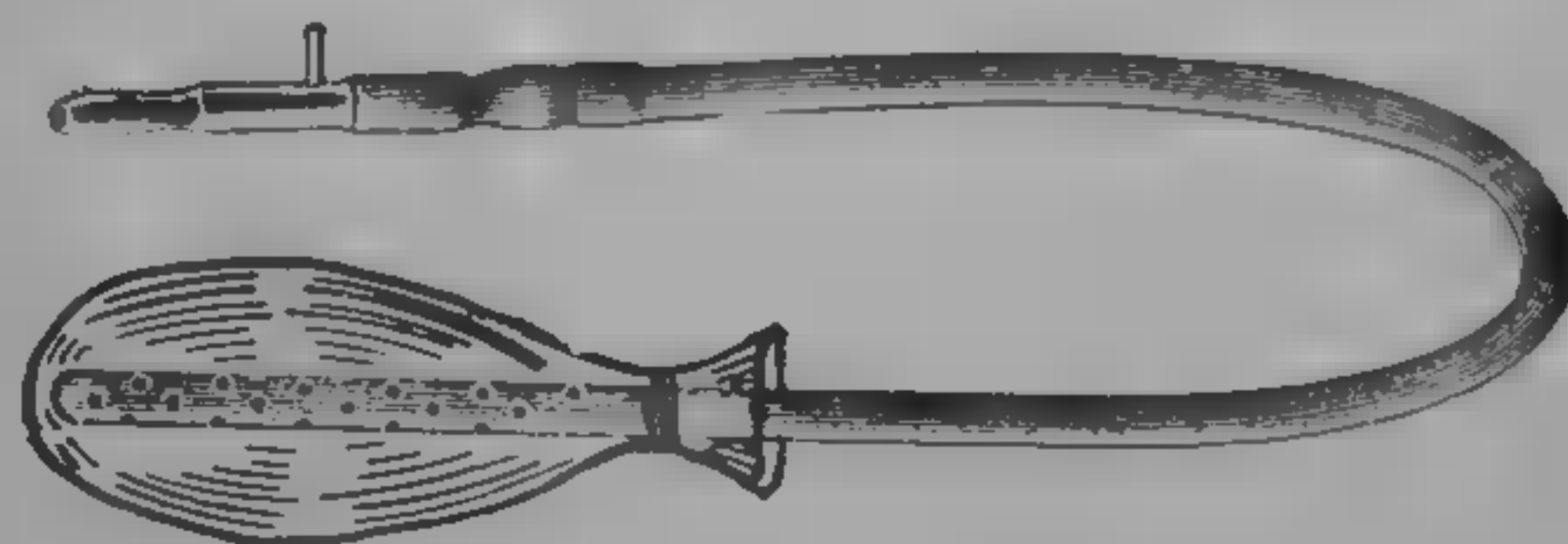


Fig. 38—Neiswanger Bag Electrode.

phate in the solution, and do not have it stronger than one or two percent. I usually employ the copper sulphate solution and I put in just enough of the copper sulphate to give the hot water a distinct greenish color.

The electrode is introduced in the collapsed form, and then filled with the solution, which either may be put in through a good-sized syringe, or by attaching the irrigator tube to the end of the electrode. A towel around the

electrode and anchored by the sand bag which holds the negative pad on the abdomen, will keep the end of the electrode from dropping down and spilling the solution. In putting the bag on the electrode, there should be left about one inch between the rubber tubing and the end of the bag, otherwise there will be too much pressure at this point. Also, when distended with the solution, a small part of the bag should extend outside of the vulva, so that Bartholin's gland and duct, which are favored sites of infection, may also receive the benefit of the treatment. 20 milliamperes for 20 minutes is the average dose. In case of severe conditions or those of definite specific origin, the time should be greatly increased, even as long sometimes as an hour.

This electrode is ideal for these vaginal conditions, because it fits more closely to the vaginal wall than any metal electrode and because the distention stretches out the little rugae or folds in the vagina. It also makes an admirable method of treating cervical erosions, and it may be used as a diathermy electrode with the same solution.

Cervical Erosions. As stated above, a satisfactory method of treating these cases is with the Neiswanger bag electrode attached to the positive pole of the galvanic current with or without diathermy in conjunction. Some prefer to treat erosions by the use of the disc elec-

trode, employing it as it is or with a pledget of cotton soaked in copper or zinc sulphate, between it and the cervix.

The latest treatment for cervical erosions is the use of a very mild coagulation to accomplish their destruction, ordinarily in a single treatment. 150 to 200 milliamperes is the usual dosage. Mikels was, I believe, the first to employ this method. The coagulated area separates and comes away in 10 or 12 days.

Gonorrhea in the Female. Two methods are satisfactory in treating this condition. They are diathermy and positive galvanism. They may be used separately or in conjunction with one another. In using diathermy it is necessary to remember that the heat must be maintained well above 104° Fahrenheit for half an hour or longer. This is used in conjunction with routine treatment and not as a sole method. When mixed infection is present remember that many germs will start more heat than normal cells and cannot be destroyed by diathermy.

The Neiswanger bag with a copper or zinc solution used for the same period of time, will be found essentially as effective.

Uterine Hemorrhage. In uterine hemorrhage the treatment is with positive galvanism, usually given with

the copper ball electrode. (Fig. 39.) To prevent the electrode from sticking it may be wrapped in cotton or with gold beaters' skin.

It is introduced into the posterior cul-de-sac. The negative pole is placed over the abdomen. 20 milliamperes or more are used for 20 minutes or even longer. Although some temporary benefit may be obtained when fibroids or polypi are present, this treatment is particu-



Fig. 39—Copper Ball Electrode.

larly suited to the ordinary cases of menorrhagia or metrorrhagia, where women flow very profusely, or for many days longer than they should and often where the pathology is vague. Treatment into the uterus with the regular copper electrodes also may be employed, but the copper ball is the one that customarily is used.

In severe cases more than a single treatment per day may be necessary. It is my rule to try and get a favorable opportunity for treatment by the use of stypticin internally. I give one stypticin tablet every hour until the flow is reduced to a mere "show," and then one every three or four hours for an additional 24 hours. It is then stopped. In the meantime the positive galvanism is em-

ployed, and right on through to the beginning of the next period. When there has been almost a sufficient amount of flow, I start in with the stypticin again to terminate the period within about 12 hours, going ahead again with the galvanism.

In one very severe case which I treated, the patient gave a history of not having been without evidence of menstruation for a longer period than three days, for eleven months. She had gone from 185 down to 110 pounds. I used the method indicated, obtaining a ten-day intermission the first time, two weeks the second, and the third month she went the full intermission. Considering the severity of the case, the results were remarkable.

Diathermy is contra-indicated in these cases.

Amenorrhea. In cases where there is a suppression of menstruation and where you are definitely certain that pregnancy does not exist, you may employ negative galvanism to bring on the flow. It is used with any metal electrode for the negative pole, the positive on the abdomen. In these cases the use of diathermy through the pelvic organs, is of definite value also, as it tends to distend the blood-vessels and increase the local blood supply.

Sub-Involution. Two methods are available. One is the use of the interrupted galvanic current with one elec-

trode over the fourth lumbar center in the spine, and the other in the cervix. Contractions will occur with each interruption of the current. Treatment should not last over five minutes. The positive electrode is in the cervix.

A better method is the use of the interrupted rapid sinusoidal current, which may be used with one large metal electrode in the vagina and a covered electrode over the fourth lumbar; or both electrodes may be placed on the spine separated a little distance from one another. The vital point is that the fourth lumbar center, which is the uterine center, shall be covered by one electrode. Treat for five to seven minutes.

Infantile Uterus. The treatment for infantile uterus is the same as that for sub-involution, because the exercise of these undeveloped muscle fibres will cause them to increase, the same as the exercise of muscular tissue elsewhere. The sinusoidal method is precisely the same as in sub-involution, but in using galvanism, we employ the negative electrode in the tiny cervix, with the positive over the fourth lumbar, because of the dilating effect of the negative pole.

Dysmenorrhea. For simple dysmenorrhea of the type where the pain is present before the onset of the flow, ceasing when the flow is established, I find that I can get more prompt results with the use of prolonged vibra-

tion over the seat of the pain than I can with any other measure.

The cause of the pain in these cases is a mechanical one. These patients are found to have long, narrow cervix and a tiny "pinhole" os, and usually there is more or less ante flexion. The pain comes from the effort of the flow to get past the obstruction thus offered, and occurs until sufficient relaxation takes place to permit the establishment of menstruation.

Hold the vibrator steadily over the seat of the pain for 8 or 10 minutes, until thorough inhibition and relief is produced. This gives positive results for the time being, but of course, has no curative value whatsoever.

For the purpose of getting permanent relief it is necessary to gradually dilate and enlarge the cervical canal, through the use of negative galvanism. The regular cervical electrodes in graduated sizes may be employed for this purpose, but usually the olive points are employed. Start with the smallest olive point attached to a staff that has not too much of a curve. This is the negative electrode. The positive is a pad on the abdomen. Make gentle but firm pressure of the olive point in engaging the tiny os. Turn the current on slowly, 8, 10, 12 or more milliamperes, and in a minute or so the cervix will relax and the olive will slowly pass on through. Let it go past the internal os, then draw it back, but not out,

and let it pass a second or third time through the cervical canal.

The caustic soda liberated will cause a certain amount of inflammation, which will subside in about four or five days, at which time, say every five days, the treatment is to be repeated, using at each sitting the next larger-sized olive. In this way the cervix may be gradually enlarged to a suitable size, to lessen the mechanical obstruction present.

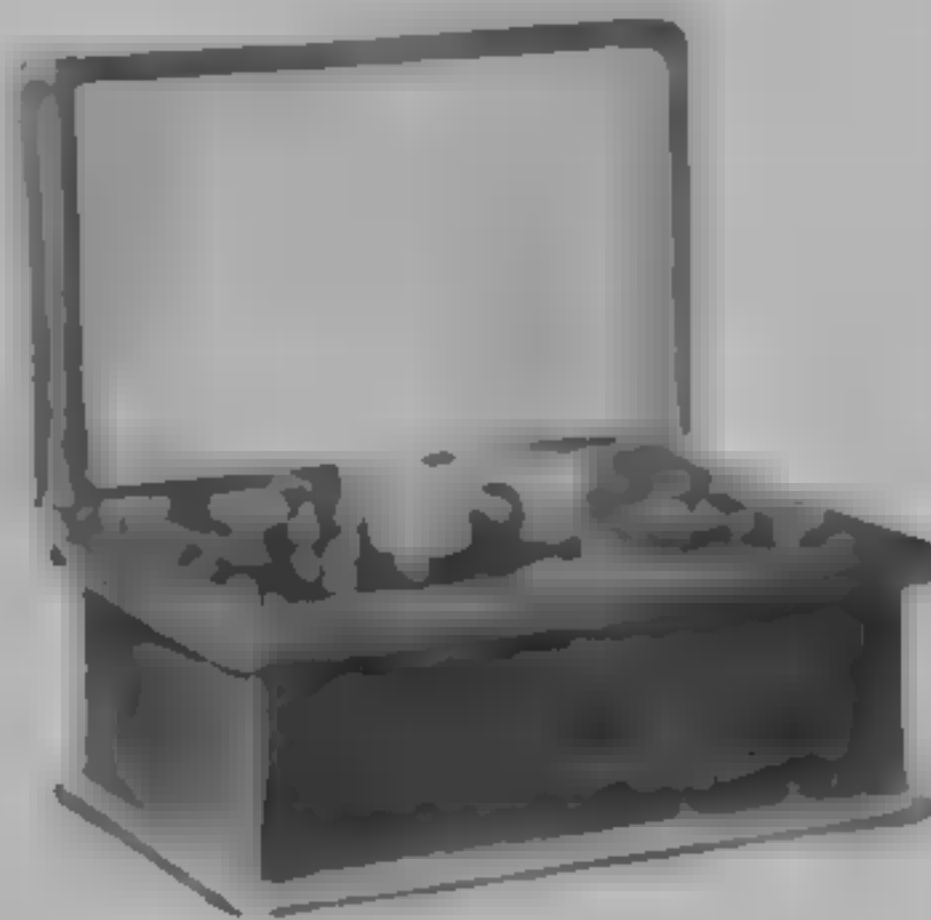
Before this has been accomplished, a menstrual period will have occurred, and vibration will have to be used for its temporary relief. Then wait two or three days and resume the treatments. The reason for waiting two or three days is that if you employ negative galvanism right away, it will tend to bring on a return of the flow.

In the **neuralgic type of dysmenorrhea**, any of our methods which generate heat, will give relief, such as diathermy. Positive galvanism used with the copper ball in the cul-de-sac, and the negative pole on the abdomen, has proved effective in these cases.

Also sometimes there has been employed the rapid sinusoidal current with two pads, one on each side of the fourth lumbar, using the treatment for 8 or 10 minutes.

In the **obstructive form of dysmenorrhea** where there is a tendency to the formation of a false membrane, the best treatment is the use of negative galvanism, using the

ordinary copper electrode on the negative pole, and introducing same up into the fundus. Use a little larger electrode each time, giving a 15 or 20-minute treatment, with 10 to 15 milliamperes of current, and giving a treatment every five days. About five of these treatments should be sufficient for a cure. Tell the patient that she will experience a considerable amount of colicky pain following the treatment, as a rule.



Portable Diathermy

Urethral Caruncle. This is destroyed easily and thoroughly by desiccation. Use about an eighth-inch spark to thoroughly desiccate after having anesthetized by placing over the area a pledget of cotton soaked in 2% butyn, or in a solution containing 10% cocaine and 5% carbolic. Let the anaesthetic remain in contact for six or eight minutes before attempting to desiccate.



One Method of Using Diathermy in Sciatica.

CHAPTER TWELVE.

Genito-Urinary and Prostatic Diseases.

Gonorrhea in the Male. The value of diathermy in gonorrhea in the male is just as great as in the female, but it has not proved nearly so satisfactory because of the difficulty in localizing the heat as desired in sufficient intensity.

It is at all times desirable to remember that gonorrhea has present other germs besides the gonococcus and many of these streptococci and staphylococci will resist heat up to 132° or more, so that they cannot be killed by diathermy without killing the normal tissue cells. For this reason diathermy should not be employed as a sole treatment, but always in conjunction with recognized routine measures.

A technique which is useful for diathermy consists in using an active electrode cut out of sheet lead, about $\frac{1}{4}$ inch thick; 1 inch wide; and long enough to extend from glans back to membranous urethra.

The indifferent electrode is a sheet of block tin 12x24

inches, or preferably, the thin auto-condensation pad may be used.

Patient lies on back on the larger electrode with penis brought up on abdomen, thus leaving the urethral surface uppermost. Plenty of soap lather or other contact medium is used, particularly in the crotch.

The narrow electrode extends the length of the available urethra and is held in place by a sand-bag above and by others crowded into the crotch. At times the patient has held this electrode in place.

The capacity of the lead electrode usually will permit 1000 to 1200 or more milliamperes to be used for about half an hour. It may be repeated in 4 to 6 hours if deemed advisable. The great disparity in the size of the electrodes determines the greater heat close to the smaller one.

The special table devised by Simmons permitting of the immersion of the penis in a solution for one electrode, the other over the back, enables the operator to employ up to 116° and is the best method. It is also excellent in orchitis and epididymitis.

Gleet. In chronic gonorrhea or gleet, we are not handicapped by the conditions which interfere with the use of diathermy in the acute trouble.

The ordinary steel sound may be employed as an electrode by snapping on one of the clips carrying a socket for the attachment of the cord. It is advisable to have

a piece of soft rubber about two inches square and about one-fourth of an inch thick, with a small hole for the sound to pass through.

When the sound is in place, put a little vaseline around the meatus and bring the rubber down into contact. The reason for this is that at this point is where the heat often becomes uncomfortable to the patient, and by following this method, this annoyance may be obviated.

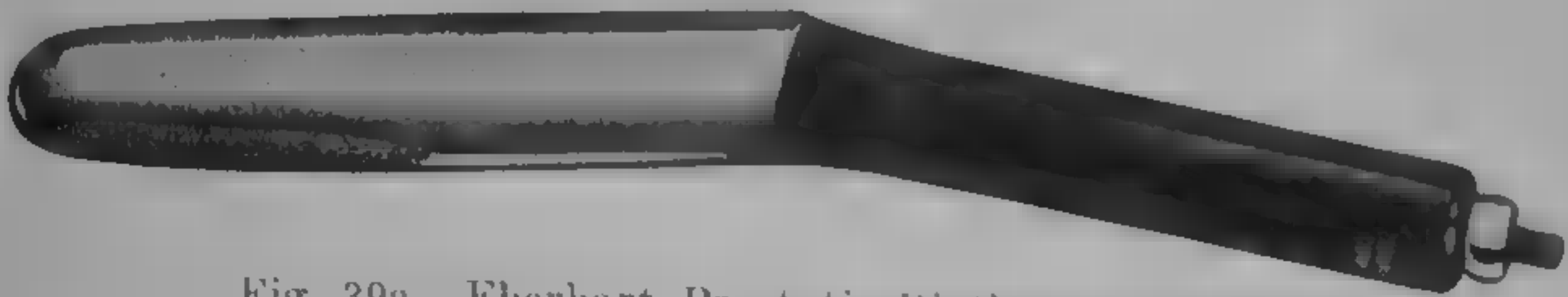


Fig. 39a—Eberhart Prostatic Diathermy Electrode.

Some also like to use positive galvanism with a special electrode for the introduction of oxychloride of copper or zinc into the posterior urethra. My preference is for the diathermic method and in alternation with the urethral treatments, I very frequently employ diathermy through the rectum, as we use it in prostatic troubles.

Prostatic Diseases. In inflammatory conditions of the prostate, especially those which follow as a sequel to infection, the value of diathermy and the surging sinusoidal was thoroughly established by the experience obtained during the war. This method is about as near a specific as anything we have.

Diathermy to the prostate is employed in either of two methods.

The first is by the use of a good-sized metal prostatic electrode, as illustrated, which is capable of carrying 800 to 1200 milliamperes of current. This is introduced into the rectum with the patient lying on his back, and a five by six block tin electrode on his lower abdomen, held in place by a sandbag. It may be necessary to use soap lather, with the abdominal electrode, as is always the case where hair comes between the skin and the electrode, which would otherwise cause small sparks and burns. It is easier to insert electrode with patient in lateral or Sims' position and then turn him on back before adjusting abdominal electrode.

The current is run up to 1000 or 1100 milliamperes, and held at this point for an average of 20 minutes, occasionally longer, and sometimes it is found desirable to increase the amperage. The patient may be placed face downward if preferred.

I find an easier way, which clinically works equally well, is to place the patient on his side in the Sims' position, with his back toward the machine and his knees well drawn up. The 5 x 6-inch block tin electrode is then introduced under his hip, with a small cushion underneath, and his weight makes good contact. The prostatic electrode is then easily introduced into the rectum,

and by putting a towel around it and bringing the ends up over his thigh, he can, with his hand, steady this towel, which makes a sling to prevent the electrode from slipping out.

After giving the diathermy, without removing the electrodes, disconnect the cords from the d'Arsonval or diathermy terminals and connect them to the terminals of the sinusoidal current, turning the selector switch to surging sinusoidal. Turn on the current to comfortable toleration of the patient and let it run for five minutes.

These treatments are best given daily at first, but quite successful results follow three treatments a week.

In the senile prostate we cannot expect to produce the same reduction in size as we do in those cases where there is a recent inflammatory infiltrate, but I have seen pronounced decrease occur even in senile cases. I am very careful, however, not to make any rash promises in these cases. What I do say to the patient is that where he has been having to get up four or five times at night, and thus not only having his rest broken, but also taking chances of exposure and cold, that by the use of this treatment he may reduce the number of times so that he will probably only have to get up once along toward morning; and this in itself is a sufficient relief to make it well worth undertaking the treatment.

Occasionally where catheterization has been necessary,

you may obtain so definite an improvement that the catheter may be discarded. The method of treatment is just the same, the combination of diathermy and the surging or alternating sinusoidal current. In some of these cases I also use vibration through the rectum to the prostate. In all instances eliminative treatment, such as Tesla auto-condensation, in conjunction.

Functional Impotency. One of my early observations in using the high frequency current to the prostate, was the fact that in many elderly men a pronounced rejuvenating effect followed. This suggested employing the current for impotency. I use for these cases at the present time, the same diathermic prostatic application that is referred to above, but in place of the surging sinusoidal current, I find that the very best form of sine wave for these cases is that known as the super-imposed wave. This requires the use of two covered electrodes which may be placed with one over the twelfth dorsal, which is the prostatic center, and the other over the pubic region, or even low down on the spine. Some prefer to use two small pads, one on each side at the twelfth dorsal. Use the current to comfortable toleration for five or six minutes.

Orchitis and Epididymitis. The best method for both of these conditions is the use of diathermy. Where the testicle is swollen to large size, the method of treating

through with a block tin electrode back and front to carry the heat through the swollen gland, is satisfactory.

Where the amount of swelling is not very great, the electrodes are so small that the amperage is not sufficient to get in very much heat without getting above the maximum dosage for the size of the electrodes. In these instances it is better to use a large electrode over the lumbo-sacral spine, say eight by twelve inches, and have the patient draw the scrotum up over the abdomen and use a small electrode over the seat of the inflammation. This makes it possible to employ a larger electrode for the active one than could be used where the electrodes were placed with both in contact with the scrotum. The average treatment will be 30 minutes, but a longer treatment is recommended, and the pain-relieving effect of such a treatment is very marked, as well as its influence on the pathology. In cases where the scrotum cannot be drawn over the abdomen apply smaller electrode on scrotum and larger on patient's thigh.

Cystitis. Several methods have been found satisfactory in this trouble. Ordinarily diathermy is used with the vaginal electrode in women, or the prostatic electrode in men, according to the usual technique. In children or adults, where so desired, a large posterior electrode with a smaller one over the bladder area, may be used to carry the diathermy current directly through the bladder

area. Half-hour treatments are recommended, the dosage being in accordance with patient's comfortable toleration.

The use of the Neiswanger bag electrode with positive galvanism has also proved satisfactory in cystitis. Remember, too, that the Neiswanger bag electrode may be used for one diathermy electrode.

Urethral Stricture. The principle involved in the treatment of urethral stricture is the use of negative galvanism to soften the scar tissue and also to dilate and enlarge the caliber of the stricture. The method is suitable in about 80% of the strictures encountered.

The insulated urethral staff is employed with gradually increasing sizes of olive points.

A sound or bougie should be passed of the largest size which will go through the stricture. It is a good plan to note on the staff of the sound about how far in the stricture is situated. Then take the sound and compare it with the olive points selecting the olive which is next larger in size than the sound which passed the stricture. This olive point is screwed on the urethral staff and the latter attached to the negative pole of the galvanic current and then introduced into the urethra and brought in firm contact with the stricture. The positive pole is a 4 x 6 pad on the abdomen or it may be attached at any convenient point.

The current is slowly turned on, up to six, or eight,

or more milliamperes in accordance with patient's toleration. In from one or two to six or eight minutes, as the case may be, there will be a gradual dilation of the stricture and the olive will pass through. It is a good procedure to draw the point back and let it pass a second, or even a third time. As the olive bears particularly upon the scar tissue and as that has only about one-third the resistance of normal tissue to the current, there is a selective action resulting. The caustic soda liberated causes a little inflammation and five days should elapse before a second treatment is given. At this time use the next larger olive point. In this manner the caliber of the stricture is gradually enlarged to a suitable size and much of the scar tissue softened and absorbed. Occa-

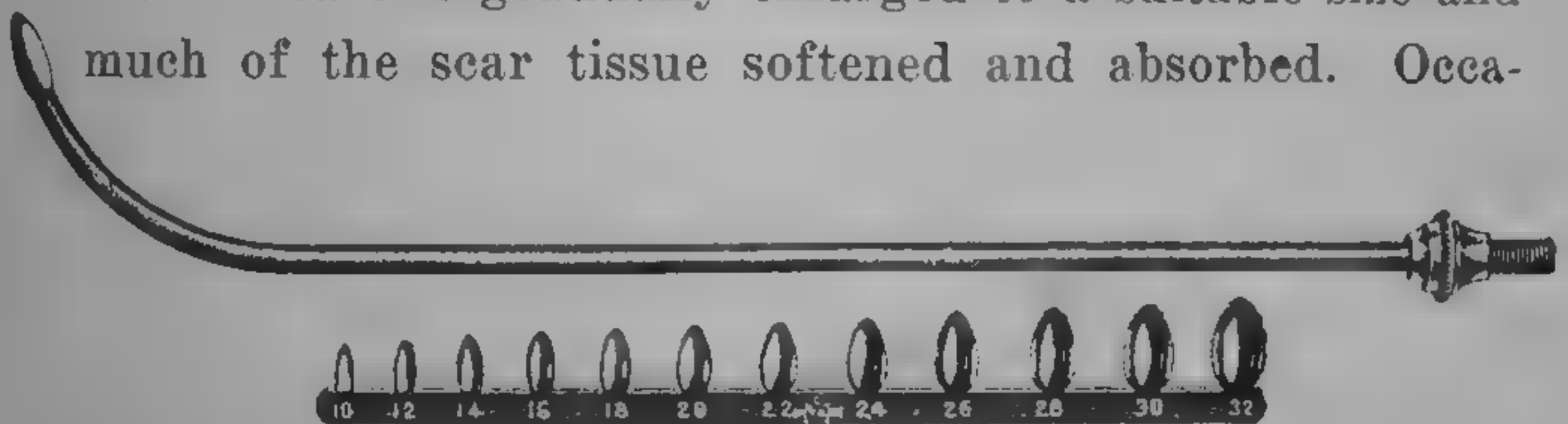


Fig. 40—Staff and Olives for Urethral Stricture.

sionally the same-sized olive may have to be used for two seances. When the desired result has been obtained, instead of abruptly stopping the treatments, use this final size at intervals of 10 to 14 days for a few times to guard against possible contraction, which might take place if treatment is discontinued too soon. (See Figs. 40 and 41.)

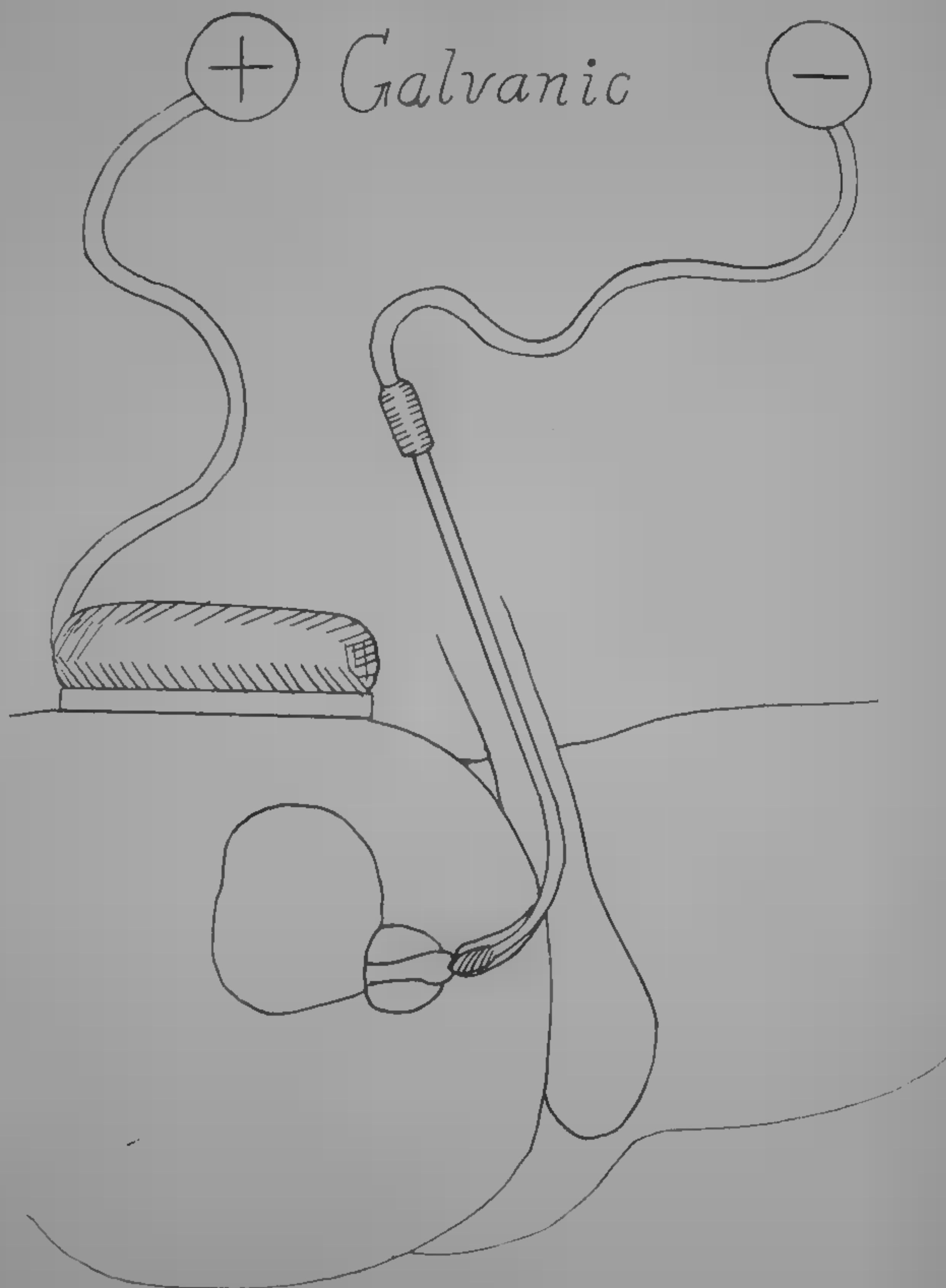


Fig. 41—Diagrammatic Illustration of Technique for Stricture.

CHAPTER THIRTEEN.

Skin Diseases.

In General. In the treatment of skin diseases there is often an over-lapping in the action of the various modalities. Improvement follows in the ordinary case with the use of high frequency, ultra-violet or X-ray, used independently of one another, and many times a suitable combination will give even better results.

When the spark from the high frequency current is employed, it is used either with the direct or indirect method with a vacuum or non-vacuum electrode, where the latter is kept in light contact with the surface treated and passed back and forth over this area. If the electrode sticks on the skin, a little talcum powder may be dusted on, or a single layer of gauze laid over the surface. In the direct method usually enough current is employed in the electrode that if a spark is drawn from it, that spark will be from one-fourth to one-half inch in length. By keeping the electrode in light contact, however, no long or disagreeable spark is felt by the patient.

In cases where there is considerable itching, as in eczema or psoriasis, the raising of the electrode to produce a more definite spark, is found quite agreeable to the patient, as it gives at least a temporary relief from the itching. Sometimes it is better to lay a definite number of layers of gauze over the surface, and thus insure an even spark.

If the high frequency is used by the indirect method, the patient is attached by a handle or by sitting on a chair pad attached to one pole of the Tesla current. The charge that is in the patient's body is grounded through the operator and may be made use of as either a mild or heavy spark, or by holding the finger in steady contact over a small area, heat may be localized at this spot. In my own work I prefer the use of the indirect method.

In all skin diseases there is calcium deficiency, consequently a direct indication for general irradiation with long ultra-violet.

Acne Vulgaris. In the treatment of pimples a mild spark, either direct or indirect (Fig. 42) is used locally over the area involved for six to ten minutes, daily or every other day.

If using the indirect Tesla, where there is a pimple that appears considerably inflamed, it is advisable to hold the fingertip for a moment over this pimple to get the effect of the very marked heat produced. Once in

five days a mild stimulating dose of X-ray is used to the face. For this purpose the face is protected, except over the area to be treated, a 15-inch target-skin distance employed with no more than one milliampere in the tube

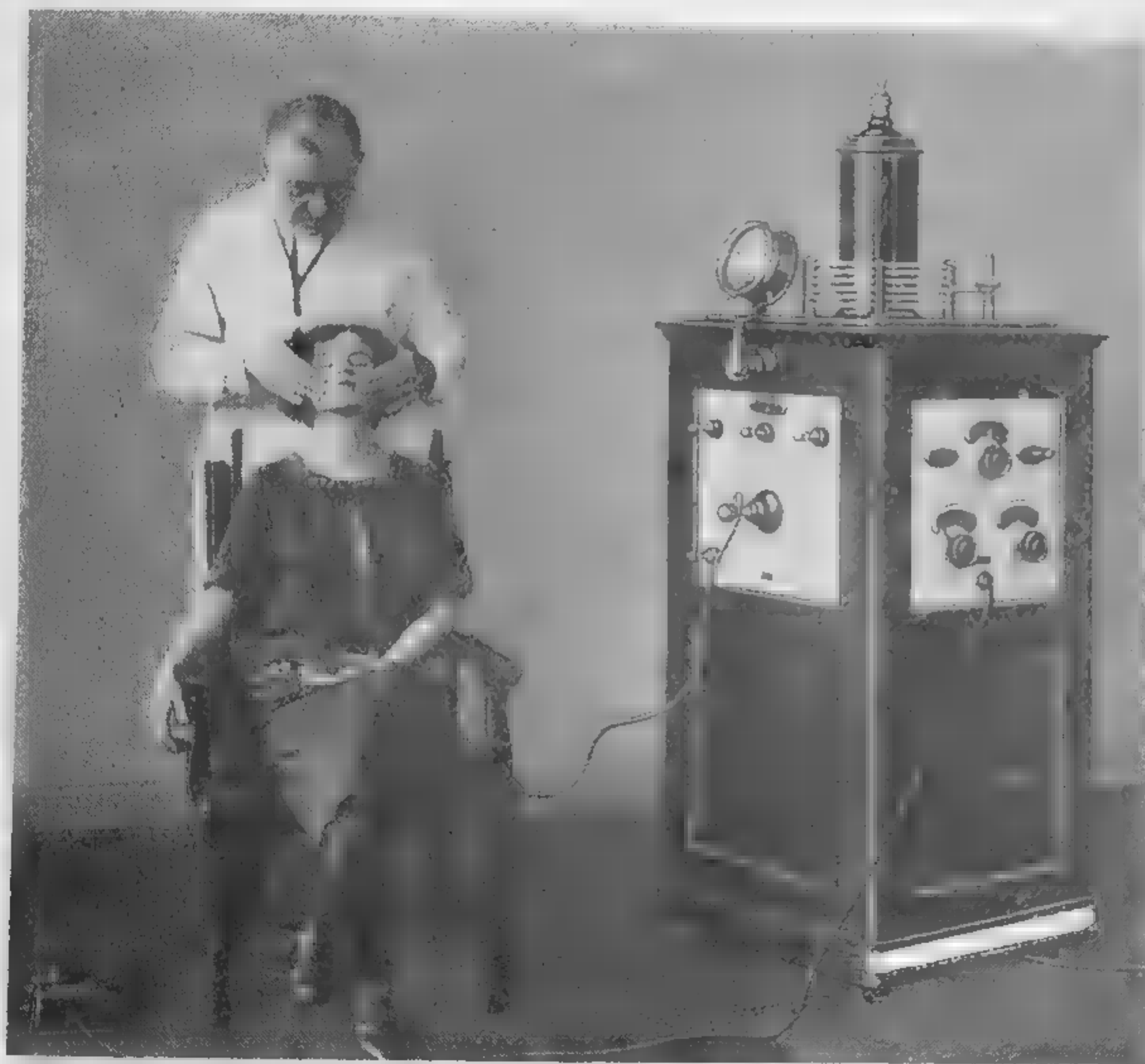


Fig. 42—Indirect Tesla Treatment of Acne, etc.

circuit, and scarcely any back-up, not more than two inches, and a five-minute exposure without filter over each area. It is important that we get only the stimulating action of the X-ray on the skin.

When pustules have formed I am very much opposed to deep lancing, because it is always followed by a scar. Take a sterile needle and just open into the yellow head; then with the shaft of the needle, take out the pus which is ready. After this apply a few fairly sharp sparks, which is a mild fulguration, making use of the germicidal action of the spark.

The high frequency treatments in the beginning should be given daily, and less than three times a week is useless. Improvement in the case will be noticed after a very few treatments. The patient may be the last to note this improvement, because he or she sees the face many times a day and does not notice the change as quickly as an outsider.

In all these cases remember that the skin is under the control of sympathetic nerves, also the blood vessels and glands, and therefore, it is quite easy to understand the effect that reflexes from the viscera, which are also controlled by the sympathetic, may have on the skin. It will be observed, for instance, in women, that the pimples are always worse around the menstrual period. Probably many cases of acne are influenced by the patient eating pastry and other starchy or greasy food, and reflex influence from the stomach, since the solar plexus is the largest of the sympathetic centers, is very common. Next in importance is the reflex from the hypogastric

plexus which governs the sexual apparatus. It is needless to suggest that any accompanying conditions which may have an influence on the acne, should receive proper treatment.

My experience is that there are no cases of acne that may not be cured by a persistent use of high frequency and X-ray. I have also used the high frequency in combination with the ultra-violet ray, with very satisfactory results, and if you do not have the X-ray but have the ultra-violet, use it in place of the X-ray.

Acne Rosacea. Electrolysis may be used to destroy the veins, or they may be destroyed by the water-cooled quartz lamp. Carbon dioxid snow in my hands has proved very efficacious for this disease.

Eczema. The treatment for eczema is similar to that for acne, the high frequency current being used in the same manner and the X-ray or the air-cooled quartz lamp being employed in conjunction. Eczema is a disease which responds quite quickly to the action of electrotherapy.

In all of those cases where the eczema occurs as a dry patch remaining constantly in one place, definite and permanent results may be expected. In the cases of moist eczema, the outbreak will be healed quickly under the action of physiotherapy, but it does not have any par-

ticular effect upon preventing a return of the trouble at another time. In these cases the finger or the electrode is raised part of the time to give the effect of a fairly sharp spark over the surface, because of the marked relief to the itching.

Psoriasis. The treatment is similar to that for eczema, although I commonly follow the method of applying first the high frequency spark, then the air-cooled ultra-violet and finally the X-ray. The high frequency part of the treatment may be given every day, but the X-ray should not be used oftener than once a week, and the ultra-violet according to the reaction, which will make the application customarily every second or third day.

These measures have a very marked effect upon healing up the attack, but no particular effect on preventing a return. If there are not too many patches short ultra-violet with quartz applicator may take place of X-ray.

Lupus Vulgarus. I now treat these cases by giving a very definite fulguration, preferring the indirect method. Two or three treatments will usually be sufficient. The diathermy-condenser spark, at about 1/16 inch distance, has been advocated and is in effect the same proposition as using fulguration. Short ultra-violet to produce destructive reaction. Bordier uses diathermy.

Lichen. This skin disease is treated in the same man-

ner by the use of the direct or indirect high frequency spark, and often with the X-ray in combination.

Pruritus. In a general way, sharp high frequency sparks will give relief to itching. In pruritus ani or vulvæ, the use of positive galvanism with a copper sulphate solution, in the Neiswanger bag electrode, is very satisfactory, driving the oxychloride of copper into the mucous membrane.

In pruritus ani look for small sinuses under the mucous membrane, and if found, incise them. A bichlorid of mercury solution used externally with the positive pole has proved very satisfactory in the hands of some operators. It has to be used carefully, and not into the rectum or vulva, otherwise at some time mercurial poisoning may result.

When the membrane is accessible, you will find minute red points, and if these points are destroyed by mild desiccation, it will mean definite relief from the itching.

Warts, Moles, Keratoses and Small Growths. All of these may be destroyed by either desiccation or fulguration, according to the usual methods. When destroyed, if either the Oudin, or the direct uni-polar Tesla current is employed, test out the spark on a piece of metal and know just how long a spark is being used. With fulguration I prefer the indirect method, with the patient

on the chair pad and using one hand as a rheostat to regulate the spark, which passes to the metal probe held in the other hand. Experience will teach you the penetration of these methods, and if any doubt at first, be on the safe side and do not overtreat, because if the growth is not entirely eliminated at one time, it may be re-treated until it is satisfactorily eradicated.

The growth turns white with desiccation, and brown with fulguration. In either case the part treated separates and comes away in about seven or eight days. Desiccation is preferable on mucous membranes but has less heat penetration. Some trim away the desiccated or fulgurated area immediately applying a few sparks to the base. I usually leave the growth to drop off after the customary time.

In treating rather hard warts, it will be found that the spark will be deflected by the growth, and seems not to penetrate. This is usually because of the very horny layers of the skin which are present, it being like trying to fulgurate the fingernail.

There is no moisture in these horny layers of the skin, and therefore, no definite reaction to either desiccation or fulguration. Here it is desirable to put on a little bicarbonate of soda and moisten, and leave on for 20 or 30 minutes before attempting to treat the growth. Then after this it may be desirable to pare the growth down,

or soak for a while in hot water, to get some moisture into the layers, so that they will react nicely to either desiccation or fulguration. This same method, of course, would apply with callouses. At times it is better to trim away the harder layers down to those containing moisture and susceptible of fulguration.

Epithelioma. Destruction by means of desiccation or fulguration or even coagulation, is advised. 80% of these cases will respond to the X-ray, and many of them to the use of the quartz lamp, so that these modalities may be used in conjunction if desired, but a simple way is to destroy the growth entirely by the action of one of our destructive measures, fulguration being more often the one of choice in early cases.



Convenient Portable Diathermy with Stand.

CHAPTER FOURTEEN.

Diseases of the Scalp.

Remarks. There are numerous diseases of the scalp in which the high frequency current is indicated, because of its beneficial action on the circulation, and consequent nutrition of the scalp, and also because of the germicidal action of the spark. In combination with it, in most conditions, the ultra-violet lamp increases the efficacy of the high frequency, but usually must be used to the point of blistering (destructive erythema).

It is not unusual for a woman patient to apply to you with the remark that she is combing her hair out by handfuls, and she is afraid she is going to be bald. You can absolutely rely on your ability with the high frequency spark to stop this process.

The Tesla spark is preferable, and may be used by the direct or indirect method. It should not be too sharp a spark, or too long a spark, because that may have a fulgurating effect on the scalp and produce small blebs. The duration of the treatment should be from six to ten minutes.

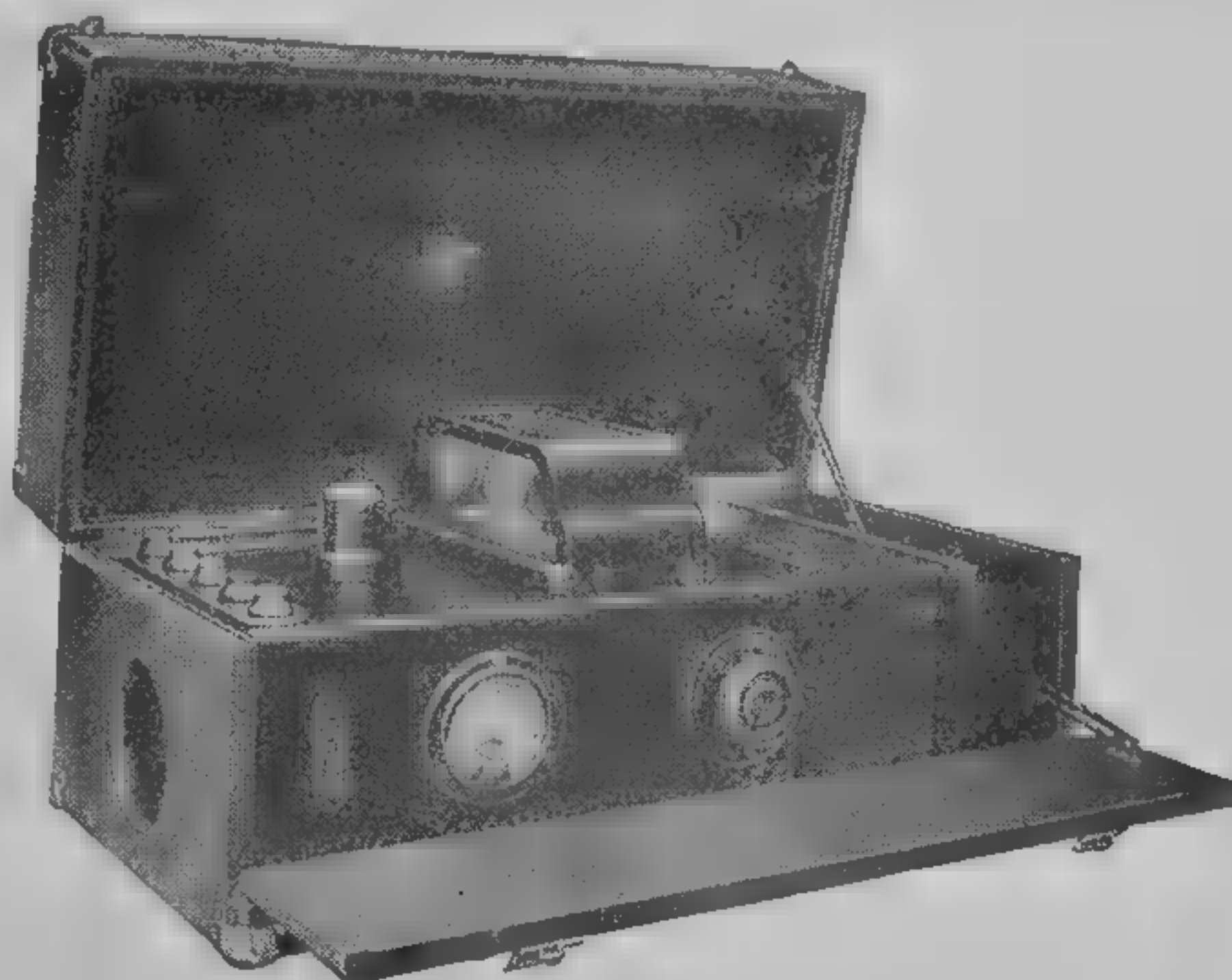
It is desirable to have the patient leave with you the amount of hair combed out at the beginning of the treatment, which you place in an envelope with name and date. In two or three weeks have her bring in what she is then combing out, and a very marked improvement will be at once noticeable by the comparison.

Seborrhea or Dandruff. The treatment of this condition is similar to that for falling hair, consisting in the application of a moderate Tesla spark over the scalp for a period of six to ten minutes. In severe cases a combination of this with a short exposure to the air-cooled ultra-violet lamp will be advantageous.

Alopecia or Baldness. For baldness, whether it be of the variety known as alopecia areata, or for the more general type of baldness, the treatment is the combination of the high frequency spark and the air-cooled quartz lamp. The quartz lamp is used at a distance of about 20 inches, and a long enough treatment given to produce marked vesication. It is important that blistering result, otherwise the treatment is not satisfactory. The water-cooled lamp has been employed without a filter, for a short close application (3 to 6 inches) to accomplish the same result. A towel may be pinned around the head at the hair line, to prevent the action of the light except where desired.

Some follow the technique, where there is still a moderate amount of hair, of wetting the hair and treating in areas, combing the wet hair every little bit, to expose a different area.

When the reaction subsides sufficiently, go ahead with the Tesla spark for about ten days and then repeat the



Portable Diathermy, Resogap Control.

blistering with the quartz lamp. If there are any hair follicles left, there will be a definite response to this combined treatment.

A physician in one of my classes exhibited his own head as a testimonial to the value of the following technique: Glacial acetic acid, one part, and vaseline four parts; applied to the scalp, and the high frequency spark used over the surface at the same time.



Method of Applying Diathermic Heat to Foot or to Metatarsal Region
with Cuff and Water-bath.

CHAPTER FIFTEEN.

Diseases of the Eye.

Diseases of the Eye. There are a number of diseases of the eye which have satisfactorily responded to treatment with electrotherapy. Much of the application has been with the use of the direct or indirect spark to the closed lids.

Diathermy has been used in two ways, with one electrode over the eyes and the other at the base of the hairline, and also in the lateral manner, through the temples.

For pain accompanying various visual defects, the rapid sinusoidal current has been employed with one sponge electrode over each eye, using a comfortable current for from three to five minutes.

Blepharitis. This condition characterized by inflammation along the margins of the lids, will yield in every case, to the application of a mild spark from either the Tesla or Oudin current. Pull the lower eyelid down, and with a small electrode there will be no difficulty in applying a mild spark along the margin of the lid, without

any danger whatsoever of any spark passing to the eye itself.

Then pull the upper eyelid up, and it is just as easily treated. If using the indirect Tesla, the fingertips may be used to draw out the spark. Some cases may have to be treated over quite a long period of time to insure success, but there should be no ultimate failures.

Conjunctivitis, Iritis, Choroiditis, Retinitis. These conditions have been satisfactorily treated in the earlier years, with the high frequency, by the use of the direct Tesla spark applied with the vacuum electrode over the closed lids. The indirect method, using the fingertips, is a better method, and some localization of heat through the closed lids, should be made by holding the fingertips stationary. In this connection I wish to state that in 1902, with the method then employed, which was the use of the spark from the vacuum electrode, I treated and cured a case of retinitis pigmentosa, which is looked upon as an incurable disease. Dr. George Suker, a well-known Chicago oculist, is authority for the diagnosis and subsequent result.

Granulated Lids. In granulated lids, the positive copper pencil electrode is used with one milliamperere of current, passing it over the area until the greenish-gray copper coating appears. This is repeated in five days.

The negative pad is attached to the arm or any convenient point.

In place of the metal copper electrode, any metal probe may be made an electrode, through the use of one of the clips to afford a socket for attachment of the cord, and a solution of copper or zinc introduced by wrapping cotton around the end of the probe and soaking it with the solution.

Stenosis of Lachrymal Duct. The use of the negative galvanic current, in conjunction with the lachrymal probes (Bowman dilators), may be used to get the dilating action of this pole. The principle is the same as that used in the negative electrolysis of urethral stricture. The positive pole is a sponge on the patient's cheek or arm or wherever convenient. The dilator of the size next larger than the one which will pass is attached to the negative pole and introduced in contact with the stricture. Turn on the least amount of current possible, which will be about one-half to one milliamperere. Very soon the dilating effect will cause the probe to pass the stricture. Repeat this treatment in four or five days, using the next larger size each time.

Blindness from Intra-Ocular Hemorrhage. In these cases Tesla auto-condensation is used, because of its eliminative properties, and because it is always useful when-

ever there is an extravasation or exudate. Use it with from 500 to 900 milliamperes for about 20 minutes. For five minutes, draw an indirect spark from the region of the closed lid and around the eyes. Daily treatments. This does not interfere with the internal administration of potassium iodide, or other remedies which usually are employed.

Cataract. Reports of the successful treatment of cataract have been made for a number of years. Noteworthy among these is that of Shelley (Archives of Electrology and Radiology, London, November, 1922).

Prior to two years ago I had considered results possible only in incipient cases and by the use of diathermy. More recently Cox and also Thometz have reported results in senile cases. I cannot confirm any of these results from my personal experience.

The method of using diathermy by Cox is to have a bi-furcated active electrode with mesh about an inch or inch and a half square on both ends, which is moistened and one placed over each closed lid. Over this a good size pad of very wet cotton is placed, thus keeping the mesh from sparking and also increasing the capacity of the electrode. A small sand-bag holds the electrode in place.

The indifferent electrode is of T-shaped block-tin, plated with the narrow strip extending up over the nape

of the neck. He uses plenty of voltage, but a very tiny spark-gap. Says the appearance of a white line around the margin after some three weeks of treatment is an indication that he is beginning to influence the case, 30-minute treatments.

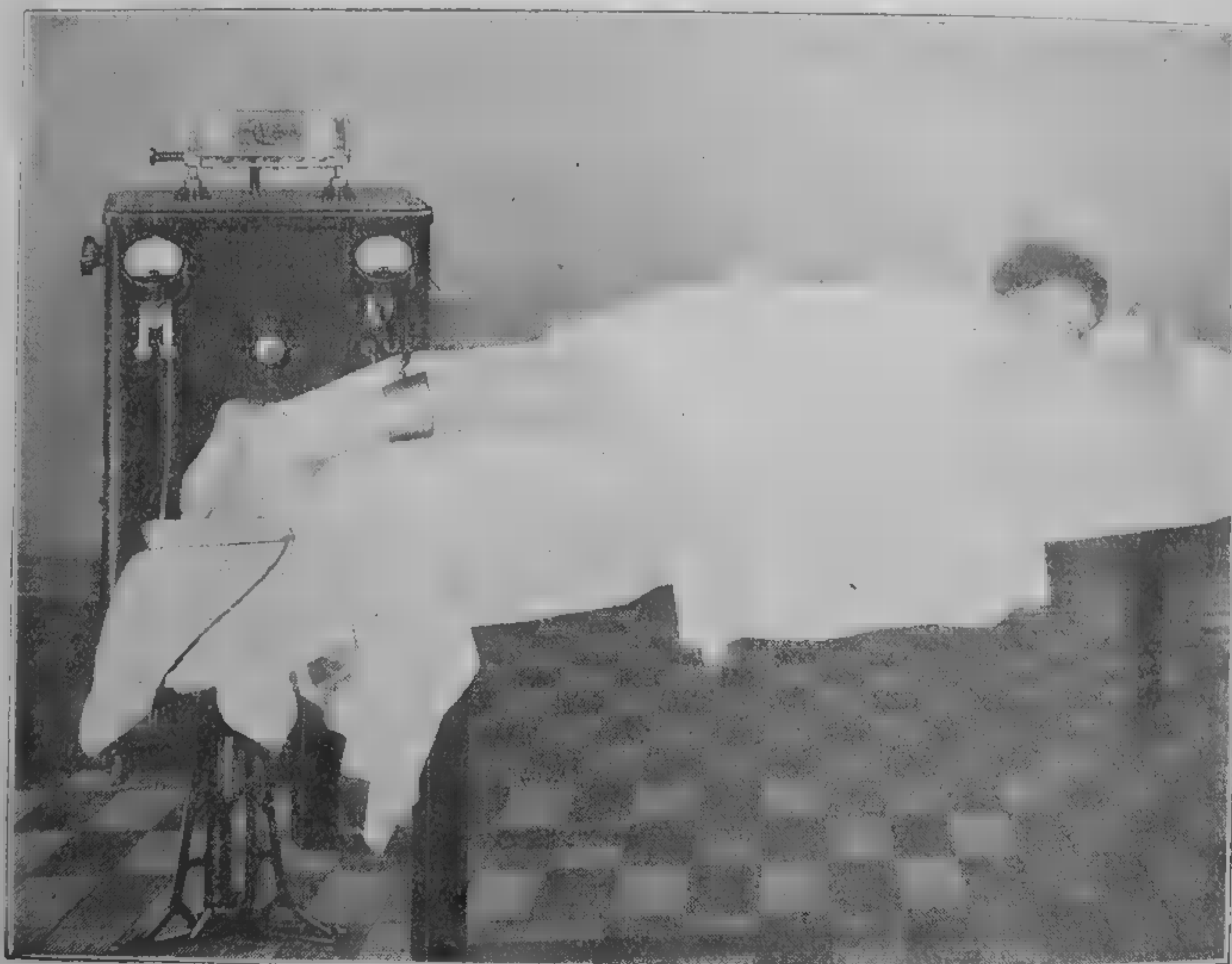
Try this method, no harm will result, but do not necessarily anticipate that success will follow.



Portable Diathermy.

Optic Neuritis. Use indirect Tesla method with the fingers over the closed lids and about the angle of the eyes, giving a moderately long treatment of say 15 to 20 minutes. The use of the surging sinusoidal current has been recommended, some employing with one electrode in the nose.

Glaucoma has been successfully treated by the use of auto-condensation and the localization of an indirect Tesla spark over the closed lid. Mild mechanical vibration through the fingertips over the same area.



Another Method of Applying Diathermy to Foot, where Heating of Metatarsal Area is Desired.

CHAPTER SIXTEEN.

Diseases of the Ear.

In General. Among the diseases of the ear which have been treated by physiotherapeutic measures, catarrhal deafness has shown probably the greatest percentage of successful results. The localization of heat in the ear, by either the indirect Tesla method or by the diathermic method, has proved definite for earache. It is probable that as these currents are better understood our specialists will apply them to get results in many conditions which so far have not responded as they should.

Deafness. I use the following classification of the cases of deafness which are to be treated, and this is purely a clinical and treatment classification:

Form	Treatment	Improvement in
1. Catarrhal Deafness	Diathermy; Surg. Sin.; Vibration	90%
2. Internal Ear Deafness	Tesla and Int. Sin.	1%
3. Otosclerosis	Diathermy; Surg. Sin.; and X-ray	less than 1%

1. **Catarrhal Deafness.** There are practically no cases of catarrhal deafness which will not show a definite response to physiotherapy methods. In about 10% of the cases this will not be a sufficient improvement to be recognized as of definite value, but in the other 90% it will be.

This does not mean that hearing will necessarily be entirely restored, but if the patient can hear a loud ticking watch 12 to 14 inches away when the range was only two or three inches at the start, that would be considered a sufficient amount of improvement to warrant the treatment.

Improvement will vary all the way from 25% to 100%. It is well to consider for a moment what we have in these cases, in order to see the logical application of the treatment. Here continued catarrhal conditions have produced deposits which more or less firmly bind the ossicles, so that the vibrations are not carried in from the drum to the nerve as they should be. Testing with a C tuning fork will show that the range of hearing through the natural canal is very limited or may be absent. Applying the same test with the tuning fork to the mastoid, and the tones are heard distinctly and normally, lasting an average of about 15 seconds.

This shows that bone conduction is better than the natural conduction, and in these cases definite results

may be anticipated from the use, first of diathermy with its powerful heat, to soften the catarrhal deposits, followed by the surging sinusoidal current and mechanical vibration, to break up the adhesions while they are soft.

Diathermy may be applied in several ways. The double ear electrode may be used, either in the external manner with the electrode surrounding the ear, which will be found very satisfactory with my new electrode (Fig. 44) or it may be applied with cotton moistened in salt solution, packed in the ear, and also covering the end of the electrode. Dr. Pollard's electrode for ear diathermy is an excellent one. (Fig. 43.)

Do not pay any attention to your meter ordinarily, but in using diathermy only go by the toleration of the patient. Turn the current on gradually and do not try to get it too hot. As the time passes, the amount of heat will naturally increase.

One great difficulty we have is that the electrodes are comparatively small and a very slight difference in size will make one definitely hotter than the other, and it may be necessary to add a little moist cotton to this one to even its area and prevent this unequal heat. This is particularly the case when the "ice-tongs" type of electrode is used.

With this form the electrode is attached to one pole of the mild diathermic current, and the other terminal



Fig. 43—Dr. Pollard's Diathermy Ear Electrode.

goes to a large metal handle held by the patient. The other electrodes have sockets for the direct attachment of the two diathermy cords. The average treatment is 20 minutes with the diathermy.

Some very remarkable results have been obtained by an instrument combining the action of the high frequency and the radio, in many cases of deafness, some of them congenital.

Diathermy may also be applied with the patient or operator holding two ordinary metal electrodes and carrying the heat through into the ear from the fingertips. Undoubtedly a specialist may devise an electrode by which one terminal will be inside the throat to the eustachian tube and the other in the external ear, and thus much more definitely reach the area involved.

After the diathermic treatment has been given, with the same electrodes apply the surging sinusoidal current for five minutes, by merely disconnecting the cords from the diathermic circuit, and connecting them into the sinusoidal circuit. The surging sine is used until a "picking" sensation is felt by the patient. Five minutes is ample. Remember that the surging sinusoidal current has very deep penetration.

After this use a mechanical vibrator, preferably with a rubber cup large enough to take in the whole external

ear. A short application of possibly a minute or so will be sufficient to get the effect of this heavy vibration, in assisting to break up the adhesions.

2. Internal Ear Deafness. In these cases the nerve itself is affected, and they respond to treatment only in a very small percentage, say about one in 100. I usually treat these cases for about a month, and if no improvement is evident, give it up as beyond the reach of my methods.

The method of treatment is with the same electrodes except that the attachment is made to the two poles of the Tesla current and followed up by the use of the interrupted rapid sinusoidal current, instead of the surging sine. Vibration may or may not be employed. It usually makes the ear feel more comfortable, but is of no definite value in this type of deafness. The X-ray, however, may be used here, and will probably increase the percentage of results.

3. Otosclerosis. For this condition the aurist offers the patient no hope. Occasional cases have been cured by following the method outlined under catarrhal deafness. In using the tuning fork in these cases, it will be observed that bone conduction is better than the natural conduction, but the difference between this and the catarrhal cases is that with the fork held to the mastoid,

the tones are heard for a much longer time (from 30 to 45 seconds). One of my students made the observation that the cases of otosclerosis cured are those of mistaken diagnosis.

Dr. Richardson of Washington, D. C., has called the attention of the Profession to remarkable results obtained in these and other cases of deafness, through the use of stimulating or ionizing doses of X-ray. My figure given above, for less than 1% of improvement, is based on the use of diathermy and the surging sinusoidal current. I have not had sufficient experience with the X-ray to be able to speak definitely, but I hope that this will greatly increase the percentage of results. These cases call for a long period of treatment, lasting over many months.

It is unnecessary to say that inflation and other methods in ordinary use, should accompany the various treatments with electricity.

Tinnitus Aurium. Ringing in the ears has been benefited by the use of Tesla auto-condensation, and at the same time using a direct or indirect spark about the ear. Mechanical vibration is also advised. Severe cases of Meniere's disease will not yield to this method.

Suppurative Otitis Media. Zinc ionization with the positive galvanic pole is the treatment. Let the patient

lie on his or her side with the diseased ear up. Bind the negative pad on the arm or at any convenient place.

Insert a hard rubber ear speculum into the ear and drop in with a dropper a 1% zinc sulphate solution to well fill the speculum. Insert a wire from the positive pole into the solution and use two to five milliamperes of current for about ten minutes or even as long as half an hour. Some remarkable results have been reported where only a few treatments were required. Treat about five days apart.

The use of the 220-soluble mercurochrome solution in the ear and then the application of the short ultra-violet through a quartz rod has also proved successful in these cases.

CHAPTER SEVENTEEN.

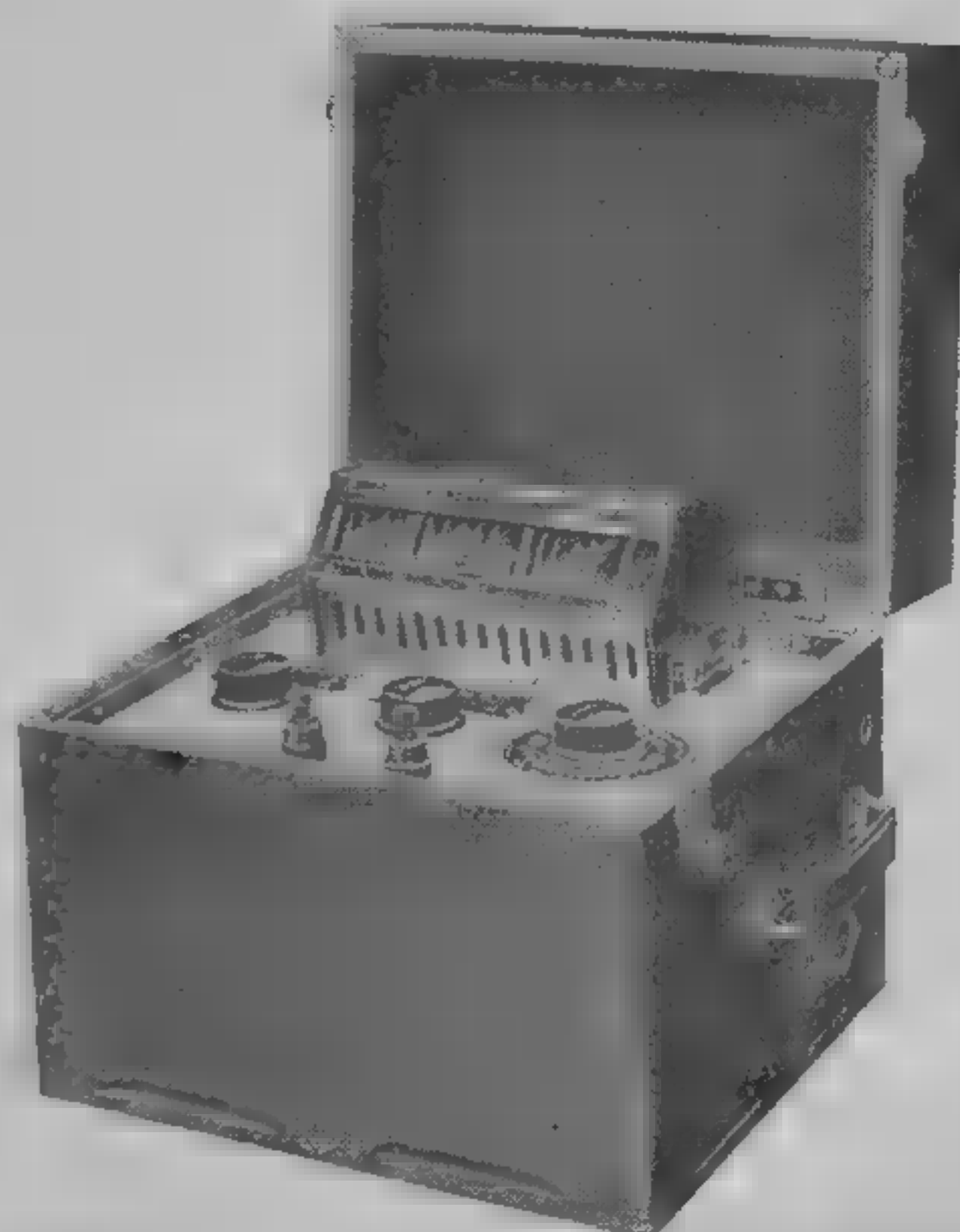
Diseases of the Nose.

Zinc Ionization. In polypi and in enlarged turbinates some very definite work has been done with the use of zinc-plated steel needles, or rods, used by insertion or by contact, and attached to the positive pole of the galvanic current. The zinc ions thus liberated, coagulate, stop hemorrhage and are germicidal in character. (See the article by Friel, London Lancet, June 30th, 1923.)

In inferior turbinates he introduces the zinc needle and employs 15 milliamperes for 30 minutes, reversing polarity in order to remove the needle. He also uses it through the naso-antral wall for antrum infection employing the same amount of current for 45 minutes.

Simple Chronic Rhinitis. For these conditions with considerable swelling or tumefaction, the positive galvanic is directly indicated. It is much more effective if used with cotton on a probe which has been soaked in one in 5000 adrenalin chloride solution. The negative pole is a pad on the arm. Three to five milliamperes are used

for about five or more minutes. Treatments are given daily until the swelling is relieved. If the secretions are found to be very acid, a few treatments using the negative galvanic pole will neutralize this acid condition.



The Electric Scalpel for Cutting Purposes.

Atrophic Rhinitis. In ozena, with its dreadful odor, the use of the vacuum electrode in the nose, with the Tesla current, has given results in tending to deodorize and benefit the disease, although I do not consider it curative. Ozone inhalations also are indicated in these conditions, and ultra-violet applications with quartz applicator. The very powerful deodorizing power of ozone will be referred to elsewhere in the chapter devoted to Ozone.

CHAPTER EIGHTEEN.

Diseases of the Throat.

Acute Tonsillitis, Pharyngitis, Laryngitis. In these acute conditions the best results are obtained through the use of the short ultra-violet to the area involved, the quartz applicator ordinarily being employed with 40 to 60 seconds' contact. This is particularly satisfactory in acute tonsillitis. Next in value is the use of a mild direct or indirect Tesla spark over the surface of the tonsil after first swabbing with a local anesthetic. This method, which is really a mild fulguration, is germicidal in character.

I prefer the indirect method. The combined treatment and coagulation electrode illustrated (Fig. 47) is a convenient one for this purpose. The patient is seated on the auto-condensation pad attached to the secondary Tesla (the large knob).

The sliding metal rod in the electrode is drawn back in the insulating canula so that it is about $1/16$ to $1/8$ of an inch from the end of the canula. Fix with the set screw. Hold the electrode in the hand making contact

with the disc on the other end of the rod. When the current is on, an indirect Tesla spark passes from the tonsil to the end of the rod. Pass this over the whole tonsil surface.

In conjunction with either the short ultra-violet or the Tesla spark, the use of infra-red externally to throat, for half an hour will prove very desirable; or use the radiant light in the same manner.

Chronic Tonsilitis. Electrotherapy has been employed to a considerable extent recently, both in the treatment of chronic conditions of the tonsil and also for their destruction or removal. I give herewith a classification which is purely for indicating the different methods of treatment and has no other significance.

Form	Treatment	Destructive Measures
1. Hard, indurated tonsils	Diathermy	Desiccation or mild coagulation
2. Soft, boggy tonsils, infected crypts	Mild Tesla Fulguration	Desiccation or mild coagulation
3. Badly diseased tonsils	None	Coagulation or removal by usual methods

1. **Hard, Indurated Tonsils.** The treatment here is based on the softening effect of the powerful heat of the diathermic treatment. Diathermy may be employed in either of two ways: First, with two small electrodes

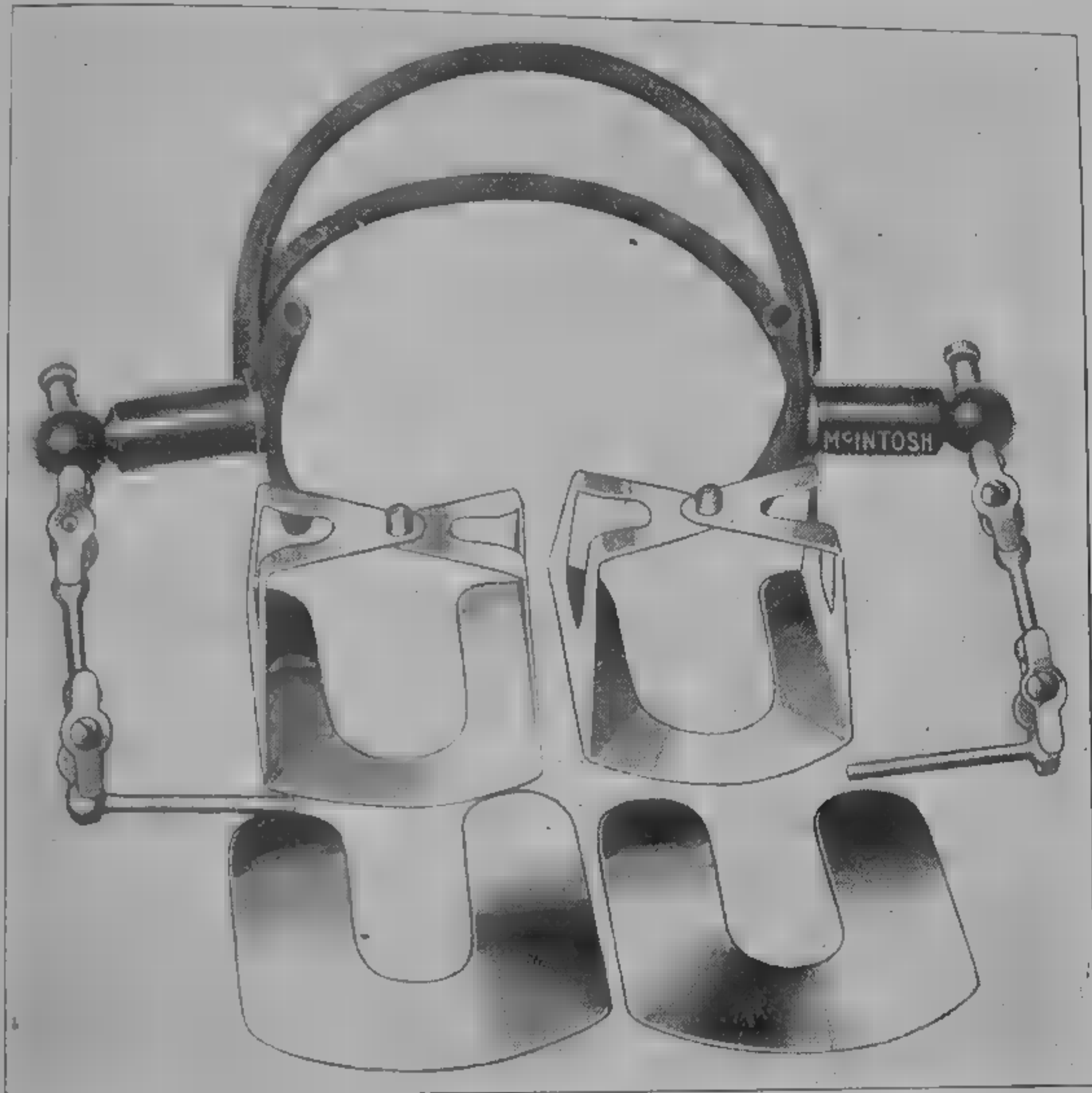


Fig. 44—Eberhart Diathermy Electrode for Ear and Throat.

one over each tonsil area externally, carrying the heat directly through into the tonsils, or it may be used by the indirect method with the patient sitting on the chair pad attached to one pole of the diathermic current, the other pole going to a metal rod electrode (the so-called tonsil electrode), which is held in the operator's hand and brought into contact with the tonsil. Painting over the tonsil first with some form of local anesthetic is desirable. This may be 2% butyn, or the use of the solution which will later be referred to, consisting of 10% cocaine and 5% carbolic in the same aqueous solution. The current is turned on gradually and moderately, and the electrode passed over the whole tonsil area. This means that a small hot point is travelling over this area with a slightly blanching effect, but not with enough current to produce definite coagulation. The treatment takes two or three minutes for each tonsil, and the feeling of the throat thereafter will be as though it had been mildly burned by taking a swallow of too hot coffee. This will subside in four or five days and the treatment may be repeated. This treatment may be used in conjunction with the first method or separately, as desired.

In case the response to the treatment is slow, or in case it is desirable to follow what is really a surgical method, desiccation or mild coagulation may be resorted to. The technique for desiccation consists in connecting

the tonsil needle in the Plank handle (Fig. 45) to the Oudin terminal. Test the amount of current by the spark that can be drawn by bringing it near to any piece of metal. Only a mild current is necessary, one that will give a spark of one-eighth to one-fourth of an inch. Apply

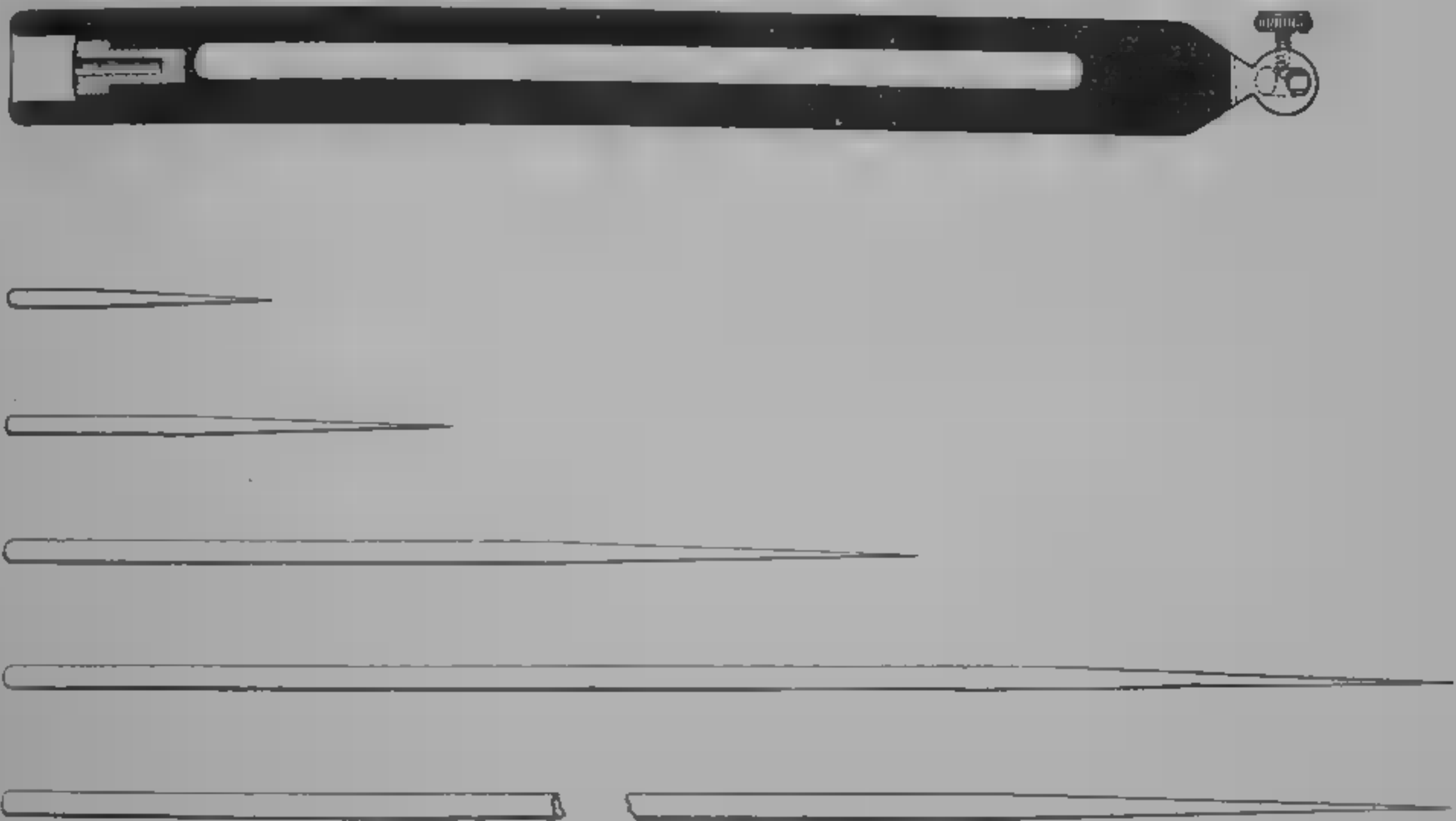


Fig. 45—Plank Handle and Needles.

this by direct contact with the tonsil, either using the blunt end of the needle and thus producing a blanching of the tonsil, or inserting the point of the needle for about one-sixteenth inch.

There are some who prefer to use a small disc for this purpose, or to bend the end of the needle and lay it on

by flat contact for a few seconds. This treatment may be repeated in a week or ten days, as needed.

Usually 7 to 10 treatments are required when desiccation is employed.

The technique for mild coagulation will be given under the method of treating the boggy tonsil.

2. **The Soft Boggy Tonsil.** There is no current which possesses the equivalent power of the Tesla to cause shrinking of tissues and at the same time the spark from this current however mild, is distinctly and absolutely germicidal. Therefore, for this type of tonsil, this is the ideal current. It has been employed in many ways. Some have found reasonably successful results attending the use of the ordinary vacuum electrode to the tonsil, employing a mild spark preferably. The more common method of treatment is the use of the indirect Tesla method, where the patient is seated on the chair pad attached to one pole of the Tesla current. (Fig. 46.) The metal tonsil electrode (Fig. 47) is held in the operator's hand. The tonsil is ordinarily anesthetized by one or two applications of either local anesthetic referred to in the preceding section. The tongue is held by a wooden tongue depressor or by the operator's fingers. This hand also serves, from the amount of contact, to regulate the current which is drawn from the tonsil and grounded through the operator's body. The electrode may be used in light



Fig. 46—Indirect Tesla Treatment of Tonsils.

contact, or, with the protecting canula the metal part may be drawn back to produce a definite length of spark of from $1/32$ to $1/8$ inch. This spark, of course, produces fulguration and is employed over the surface of the tonsil, producing a brownish-white burn. Special attention is paid to the crypts in order to destroy the germs having their habitat therein. A treatment once in five or ten days is required.

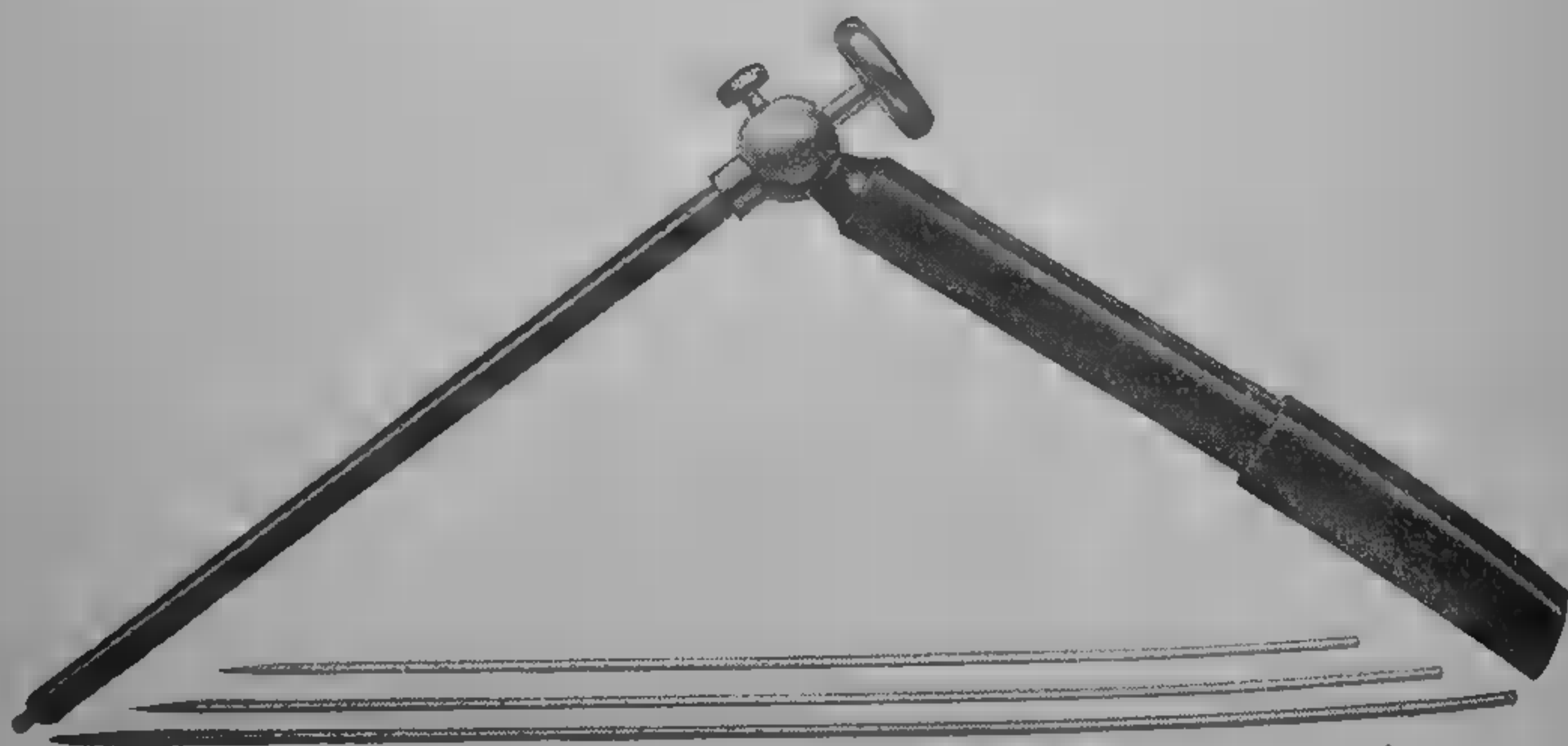


Fig. 47—Tonsil Electrode for Indirect Tesla or Coagulation.

Where this method seems too tedious, desiccation or mild coagulation is recommended. My own preference is for mild coagulation (300 to 600 milliamperes), but in the East desiccation is the most popular method.

General Consideration of Advantages and Disadvantages of Desiccation and Coagulation. The use of either

of these measures is, of course, surgery by electricity. I am going to say frankly that for the destruction or re-



Fig. 48--Coagulation of Tonsils.

moval of the tonsil in the ordinary case, I can see no special advantage in the use of physiotherapy. A clever throat specialist will peel out a pair of tonsils in minimum

time and with comparatively little after trouble. It takes much longer to destroy with mild coagulation or with desiccation. I rarely coagulate tonsils in a child under twelve years of age, which would bar out the greater number of cases. This is not because a child's tonsil will not coagulate as readily as an adult's but because you have to have absolute co-operation on the part of your patient when coagulation is used. Desiccation is not quite so difficult, but largely open to the same draw-back.

Now on the other hand there are conditions in which coagulation has the advantage over extirpation, and for these cases alone, I feel that our throat men should learn the use of coagulation and employ it in these suitable cases, using their usual method for their ordinary cases.

First and foremost let us consider the "bleeders." Here is a class of cases where the patients are not good surgical risks and many never become such. There is no hemorrhage with coagulation and it may be employed without hesitation in these cases.

Next comes a class containing patients along in years; with heart or kidney lesions; or who for one reason or another are not good patients to stand shock. There is no shock with coagulation and it is the preferable method.

There is also this point to remember and that is that the technique for mild coagulation is simple and easily

learned and many may master it when they do not seem to be able to become experts in extirpation.

There is no carbonization in coagulation and the proceeding is apparently very safe and certainly has its field.

Sterilization or Destruction of Tonsils? Here is a question which has been coming steadily to the front for two or three years; that is whether all of the tonsil shall be removed or destroyed (whether by extirpation or coagulation), or whether it may be sterilized through coagulation and much of the tissue allowed to remain.

I am one of those who started originally with the old tonsillotome used to slice off a superficial section and then became convinced that the complete removal of tonsil tissue was desirable, and that has been my attitude for years, as it is that of probably the majority of the profession.

However in the last four years a new thought has been gradually obtruding itself.

In going around over the country holding lecture courses on Physiotherapy, I customarily coagulate cases before my classes to demonstrate the technique. Going back to the same city on subsequent occasions I have frequently had an opportunity of seeing these cases again and in many of them I was chagrined to find how little of the tonsil I had succeeded in destroying, feeling that with my experience I should have accomplished more.

However, on asking these patients how they felt I was much surprised and interested to have them say in nearly every instance that the throat felt fine and they had had no subsequent attack of tonsillitis. This suggested the thought that although all tonsil tissue had not been removed, that remaining had been sterilized by the heat of coagulation and was no longer a menace to the patient.

I was therefore prepared when McPhee, Case and others set forth the idea that sterilization and not destruction is desirable, basing their conclusions on clinical observations and the idea that the tonsil has an internal secretion desirable to preserve.

I am not trying to influence the opinion of the reader, who may sterilize or completely destroy by desiccation or coagulation, or remove by extirpation as he sees fit, but I am being won over to the sterilization idea.

When we coagulate, the coagulum itself separates and comes away, but there is a considerable zone around it where the heat is intensive enough to have ordinarily a sterilizing effect.

Technique of Mild Coagulation. The tonsil is anesthetized by swabbing over it either 2 per cent butyn or cocaine 10 per cent and phenol 5 per cent in the same aqueous solution. I find the amount of anesthesia required is much less than I formerly used. As a rule, two applications, five minutes apart, will render the patient

ready for coagulation five minutes after the second application. Sometimes a third application is made. If patient has a very sensitive throat and gags easily, swab over surrounding areas to allay irritation or else let the patient dissolve slowly in the month a tablet of calcidin with anesthesine.

Formerly I frequently injected the tonsil with procaine or novacaine, but I have not found this necessary for the past two years. If there seems to be a little pain, by "flashing" the coagulation with the foot-switch it will not be unbearable, being compared to the interrupted spark used in fulguration.

The patient is seated on the thin auto-condensation pad, which is connected to one d'Arsonval diathermy terminal. The other terminal is connected to the Plank coagulation handle, the current first being passed through the meter. We will use 300 to 600 milliamperes, 450 or 500 being a very satisfactory dose, possessing distinct coagulating power but being readily regulated and not likely to penetrate too deeply.

Now we need to know before we start just about how much current we are using, as manifestly we cannot put a needle in the tonsil and then regulate our current up or down to the desired dose. We must know beforehand. There are several ways that may be employed. The patient may hold in the hand a potato or a piece of meat

into which the needle is plunged and then the current adjusted to the desired reading.

The method I ordinarily employ is to "short" my current from the needle to the other terminal. Be sure your spark-gap is turned down and that the needle does not touch the other terminal, or you might ruin your meter. Hold the needle about $\frac{3}{16}$ or $\frac{1}{4}$ of an inch from the terminal, put volt controller on second button and gradually turn up spark-gap until a spark passes from needle to terminal. Your meter will read 1200 or 1400 milliamperes on the "short" but with patient's body weight in the circuit you will find that you have about 500 milliamperes in actual use, or near enough to it that you can start with this dose and regulate up or down as may be required.

The 10-inch aluminum tonsil needle is my preference. It is covered with closely-fitting rubber tubing for insulation, the tubing being tied at the end with a thread so that only $\frac{1}{8}$ of an inch of the needle can be inserted in the tonsil. This is important, as without tying it, the needle will often penetrate much farther than you intend or desire. I bend the needle slightly near the end to facilitate its introduction into the tonsil, the point turning to my right for introduction into the patient's left tonsil and then turning it around in the opposite direction for the right tonsil.

The needle is inserted in the upper pole and the foot-switch pressed down for approximately two seconds, noting of course the amount of coagulation that is occurring. A spot possibly a quarter of an inch in diameter is coagulated. In general the penetration of the coagulation in two seconds will be about the same as the length of spark that can be drawn from the needle on the "short." Holding it a little longer will mean greater penetration. Exercise good judgment about this. Next coagulate a plug at the inferior pole. By thus treating at the two poles it is possible to destroy the circulation in the tonsil to a large degree. Then add two or three additional coagulations in the central portion of the tonsil; which may or may not be confluent. **Always avoid the pillars.** If a pillar retractor is necessary do not use a metal one. The bone crochet hooks which the women used to use, make good retractors. Wooden tongue depressors are employed. The little lamps operating from a contained battery cell and having a place for inserting the tongue depressor, are especially satisfactory as they throw a nice light on the tonsil while you are holding the tongue down.

In "bleeders" I often use the blunt end of the needle for you will find you can coagulate by contact as well as by insertion.

You may pull the tonsil forward and hold with a

tenaculum if desired. This is done by an assistant. The metal tenaculum in center of tonsil will cause no trouble.

In from six to eight hours after coagulation any reaction will take place and reach its maximum during the succeeding 24 hours. Ordinarily it is not severe and the patient says the throat is no sorer than with an ordinary attack of tonsillitis, which he is used to. Occasionally considerable edema may develop which is controlled by an aspirin gargle. Dissolve two aspirin tablets in two tablespoonfuls of hot water and let patient gargle a small swallow every 10 to 30 minutes. It seems to have a very definite influence on this type of edema. Ice bags to throat also recommended. If breath is foul any desired gargle may be used. In 10 to 12 days the coagulated area comes away. Sometimes in one mass but more often it keeps flaking off until it is all gone and more or less of a crater remains. This often appears as if more coagulation would be required. Do not make a second application in less than six weeks from the first. Many times you will then find it unnecessary; but you may repeat until either sterilization or complete destruction of tonsil results.

There are several other methods in use, but this is the one I personally use and prefer.

Be sure needle is in tonsil before pressing on foot-switch and release switch before removing needle, thus avoiding a spark.

CHAPTER NINETEEN.

Respiratory Diseases.

Bronchitis. In **acute bronchitis**, the treatment is the use of indirect Tesla over the chest for ten or fifteen minutes, used in conjunction with the high candle-power lamp; two treatments a day being advised.

Infra-red may be substituted for the radiant light. radiant light.

It is in **chronic bronchitis** that we usually have the opportunity of employing physiotherapy. For this diathermy is the treatment. (Fig. 49.)

The smaller electrode is placed anteriorly over the larger bronchi, and it is to be remembered that these are about one-fourth of the way in from the anterior chest wall. Consequently, if we wish to be technically precise, we will have the area of the smaller or anterior electrode, one-fourth that of the posterior. Many operators use it about one-third the size and as the heat spreads out from the high point, it will include the area desired, as the treatment proceeds.

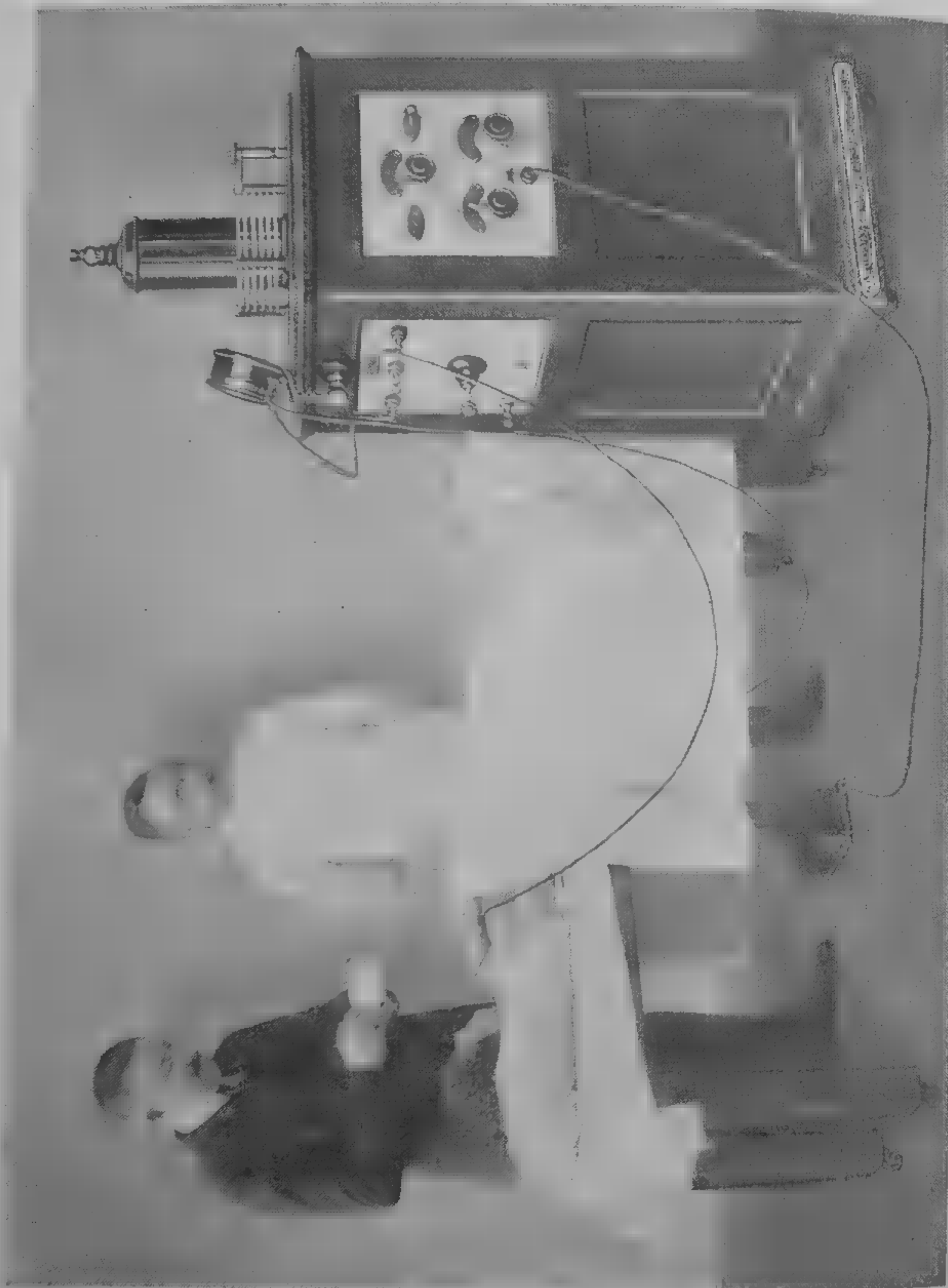


Fig. 49—Applying Diathermy in Chronic Bronchitis.

If the chest is hairy, soap lather will be required. Patient lying on back on the larger electrode, the chest electrode being held in place by a sandbag. Give the dosage in accordance with the size of the smaller electrode, using 65 to 75 milliamperes to the square inch. Treatment should be for about 30 minutes.

Explain to the patient that diathermy causes increased liquefaction of the sputum, and therefore, the symptoms at first may be aggravated. The patient will cough more, although the cough will be easy and will bring up more, but thinner sputum, than they have been coughing up previously. After a few treatments the condition will change and rapid progress ordinarily is observed. Daily treatments at first are desirable.

General irradiation with long ultra-violet is usually indicated because of calcium deficiency.

Bronchial Asthma. The treatment for bronchial asthma is identical with that for chronic bronchitis. It is my rule not to treat for the first three or four treatments, for more than 10 or 15 minutes, and seldom to use over 50 to 60 milliamperes to the square inch, because otherwise the patient may have an uncomfortable night following the treatment. After a few treatments, the dosage and time may be increased.

We do not expect a cure in these cases, but to afford the patient very definite and positive relief.

It is, of course, unnecessary to say that no improvement will result in the treatment of asthma that is of renal or cardiac origin.

The latest finding in bronchial asthma is that diathermy to the spleen is apparently more effective; causes no unpleasant symptoms and also increases the ionizable calcium. General ultra-violet irradiations are to be used in conjunction.

Pleurisy. If you have an opportunity to treat a case of pleurisy before effusion has taken place, one very long treatment for 45 minutes to an hour, with diathermy, will often entirely abort the disease.

After effusion has occurred, the best treatment is with the high-candle power lamp, cupping, and indirect Tesla, in conjunction with the usual medical treatment. **Later,** if there has been left an exudate or a thickened pleura, the best treatment is diathermy with an electrode of suitable size to cover the area and with the usual dosage of 60 to 75 milliamperes to the square inch of the smaller electrode, and a duration of half an hour.

Infra-red may be substituted for the radiant light.

Tesla auto-condensation in conjunction, will prove of definite value in causing absorption. The air-cooled ultra-violet lamp is of real value also in these cases.

Pneumonia. Treatment of pneumonia is the use of the d'Arsonval diathermic current, with a four by seven block

tin electrode back and front through the affected lobe. Should the case be bilateral, treat one side at a time. Use from 2000 to 2500 milliamperes for half an hour, and give two treatments the first 24 hours, and one thereafter, in accordance with the clinical findings. Hot soap lather is used with the electrodes.

It will be observed that the treatment with diathermy entirely changes the character of a lobar pneumonia. Instead of running along with a high temperature and a crisis between the fifth and ninth day, with a sudden drop in temperature, under the action of diathermy, the fever goes down by lysis or gradual decline. In a large series of cases there are only two on record of death ensuing where diathermy was used before the third day of the disease. The credit for establishing the value of this treatment belongs to Dr. Harry Eaton Stewart.

In a recent interview Dr. Stewart tells me that he now uses electrodes extending about an inch and a half beyond the margin of the affected lobe thus often preventing extension of the disease. He also finds longer and more frequent treatments may be used in severe cases.

There is only one caution to consider in using diathermy in pneumonia, and that is not to liquefy the chest contents too fast. The powerful heat of diathermy has a very marked effect, and I was told by one doctor that he thought he literally drowned two of his patients in their

own secretions, because the contents were liquefied too fast.

For this reason, many at the present time only use 1500 milliamperes for the dose, but by observing the action of the treatment, there will be no trouble about adjusting the time and frequency of the treatments in accordance with the individual requirements.

This method has practically abolished the mortality rate in lobar pneumonia, if the case is taken in any reasonable time.

Tuberculosis. Although diathermy is one of the best measures that we have in tuberculosis, care must be exercised in employing it, for the reason that in those cases where hemorrhages have occurred, or are liable to occur, the increased blood in the blood vessels will often precipitate a hemorrhage, if diathermy is not used with extreme care.

It is advisable to use at this time, not more than 600 milliamperes of current, and not to give treatments for longer than 10 minutes. In earlier stages, the diathermy may be given without this danger.

Of all the physiotherapeutic measures employed in tuberculosis, the air-cooled quartz lamp is the outstanding one as far as general benefit is concerned.

Treatments with the air-cooled lamp are given starting with an exposure of about one-half to one minute with

the lamp 30 to 40 inches away over each area, and gradually increasing one-half minute every third treatment. General irradiation back and front to chest or to whole body.

A second treatment should come at about the time the erythema produced by the previous treatment is subsiding, which will ordinarily mean every second or third day. Formerly I gradually increased the time up to 30 or 40 minutes, but now I do not go beyond five.

In tuberculosis we always have calcium starvation and the action of the air-cooled lamp in fixing the calcium content of the cell is directly in line with what is required for these cases. In addition, it has its general up-building effect. Of course, the quartz lamp does not manufacture calcium and it will have to be administered to the patient in some readily absorbable form. Calcium iodide or calcium lacto-phosphate are good preparations, or use one of the combinations of lime, magnesia, potassium and soda, which are on the market.

Ultra-violet is contra-indicated in advanced cases.

In my cases of tuberculosis, I like to employ the use of ozone, by having a room ozonizer, in the room which is occupied by the patient, or if the patient is up and around, let it be on a stand in the room during the day, but when the patient is in bed, it should be on a table at the head of the bed. Windows should always be open

and the ozonizing machine will increase the amount of oxygen in the air which the patient respire. My theory is that if there is reduced lung capacity but the air



Fig. 50--Water-cooled Lamp in Hay Fever.

handled by this lessened amount of lung tissue contains a greater amount of oxygen, it will keep up the balance as required by the system.

Hay Fever. Use a nasal vacuum electrode in the nose,

by either the direct or indirect method, going carefully over the whole mucous membrane. The indirect Tesla with the fingers stroking the sides of the nose and localizing the heat, is also recommended. Then with the quartz rod applicator on the water-cooled lamp (Fig. 50), insert as far as possible and expose one minute; withdraw about three-quarters of an inch and give another one-minute exposure. Do this in each nostril. Finally, with a post-nasal applicator, treat that portion as well. Give treatments for relief during the attack. General irradiation with the air-cooled lamp is advised to raise the blood calcium index.

If you can get these patients to come in four or five weeks before the threatened attack and follow out the same method in nine cases out of ten the attack will not occur, or will be so very mild as to be insignificant. Usually they do not co-operate to this extent, and wait until the attack is on and come back to the physician for relief.

Inhalation of ozone has proved beneficial in these hay fever cases also. Of course, when the vacuum electrode is used there is more or less ozone liberated locally.

The new quartz mercury electrodes combining high frequency and ultra-violet are proving useful in these cases.



Wappler Wyeth Endotherm.

CHAPTER TWENTY.

Rectal Diseases.

In General. The positive galvanic current may be used with the Neiswanger bag electrode to drive the oxychloride of copper or zine, into the rectal wall, for proctitis, or for the relief of pain. Diathermy is applied with the prostatic electrode following the technique outlined under prostatic diseases.

Vibration for Relaxing the Sphincter Ani. The steady application for a few minutes of vibration over the anus, will cause a local inhibition with complete relaxation of the sphincter which will enable the physician to introduce instruments, or make examinations which would otherwise be difficult or very painful.

The same method will enable a protruding or strangulated hemorrhoid to be returned or replaced, or with prolapse of the rectum, will facilitate the same result.

Proctitis. For the various inflammatory conditions of the rectum, the best treatment is the use of positive galvanism with the Neiswanger bag electrode, or any

other electrode which will permit the driving in of copper or zinc from the positive pole. Patient lies on his side in the Sims' position.

The negative electrode is placed under the patient's thigh. 15 to 20 milliamperes of current is the average dose, given for 20 minutes. Some rectal specialists have made use of this same principle to charge a solution with positive galvanism which is passed on up into the sigmoid and colon.

Pruritus Ani. This is best treated by positive copper galvanism, using the method given under proctitis. It has also been relieved by the use of a bichlorid solution externally with the positive pole over the gauze which has been saturated in the solution. It is always advisable to look for small sinuses in the mucous membrane and incise them if found.

Hemorrhoids. Two methods of treatment are at present in vogue, one with the positive pole of the galvanic current for positive electrolysis, and the other by means of electro-coagulation. In either case a definite degree of anesthesia is required to satisfactorily carry out the work.

As these treatments are given for the purpose of curing the trouble without causing the patient to be confined to the house, it is necessary that only a small amount of

work be done at a single sitting. If a large area is treated at one time, the patient may be kept indoors for a few days, just as would be the case after surgical procedure, and therefore, would have no special advantage.

It will be observed that piles usually occur on the posterior surface of the rectum, and therefore, anesthesia to affect that area, is all that is required.

The operator should undertake to treat one or two of the larger hemorrhoids at each sitting, or if there are a large number of small ones, treat one-third of the area at each time. In this manner the amount of pain and annoyance suffered by the patient afterwards, will be not more than he is having at all times with his hemorrhoids anyway.

For anesthesia butyn $\frac{1}{2}$ of 1 per cent may be used, or procain or novocain, 1 or 2 per cent. A new preparation called anestex, which is slow in absorbing, thus maintaining the anesthesia for a longer time, has been found very satisfactory.

Either inject around the base of the hemorrhoid to be treated or, with a two-inch needle inject a few drops just below the posterior commissure, and then with the gloved finger in the rectum, pulling down on the sphincter, pass the needle up on one side of the rectum and as it is gradually withdrawn, leave drop after drop

of the anesthetic. Then go into the sphincter itself so that the anesthesia will cause relaxation.

When this half is treated, without removing the needle, pass up on the other side and do the same. This will answer all purposes.

Either a glass or metal speculum may be employed. The metal speculum is the one that has a window or slide in it, which will expose a certain definite area for treatment. The metal speculum does not cause any trouble unless the needle comes in contact with it when the current is on. That is all it is necessary to avoid.

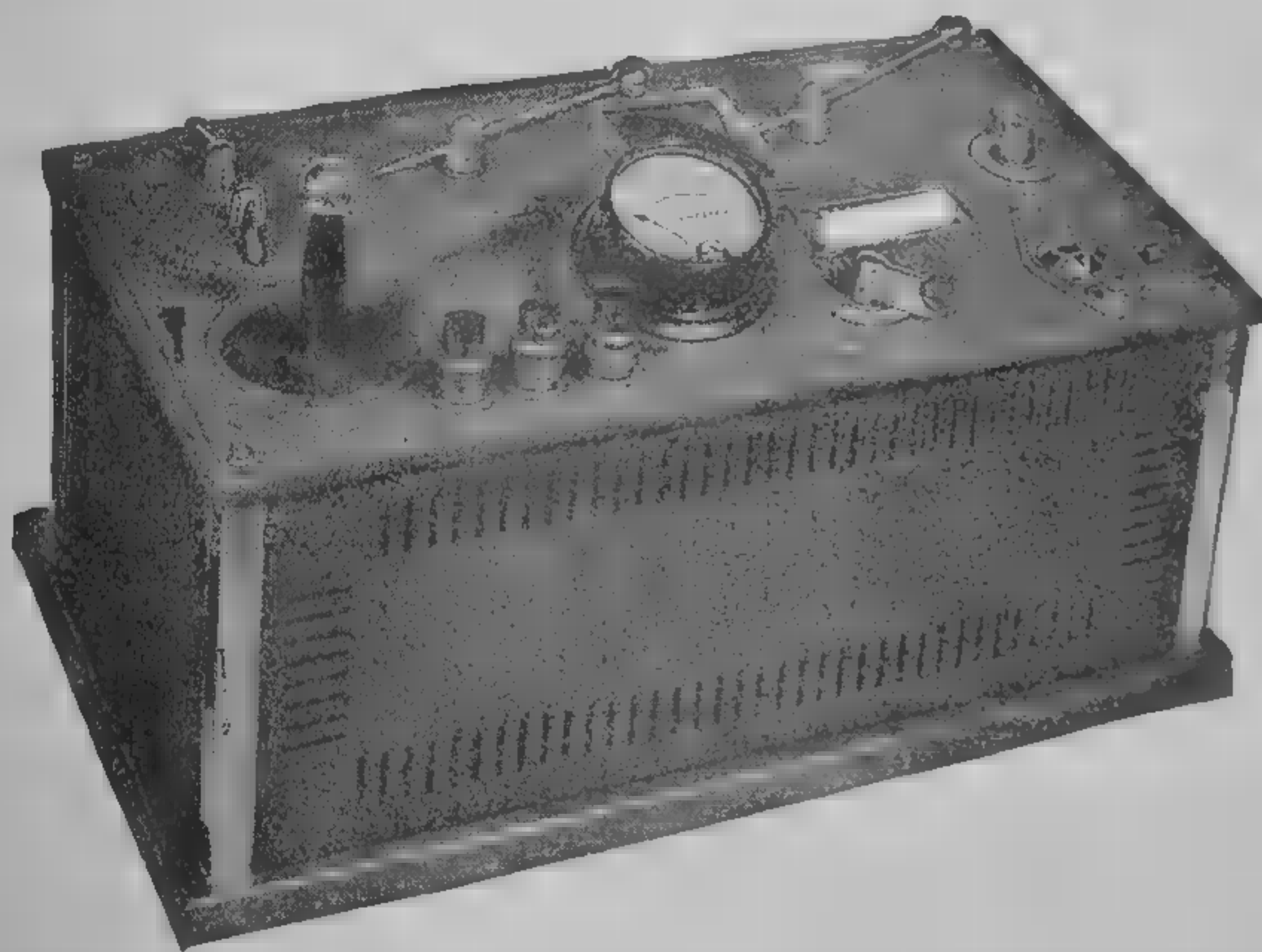
Ordinarily no speculum will be necessary.

First. **The Method for Positive Galvanism.** Use a large cambric needle for the positive electrode, with the negative on the patient's abdomen and held by a sandbag, or it may be underneath the patient's hip with the patient lying in the Sims' position. When the steel needle is used, it is only employed for that one sitting, when it is thrown away and a fresh one used at each subsequent treatment.

A better method is to have a steel needle heavily gold-plated, when it becomes non-polarizable and may be used repeatedly. In the larger hemorrhoids the needle is introduced from the top, passing down, but not quite to the base. In those which are more flattened out, go in obliquely with the needle, still avoiding the base.

Now follows what I call the "10-15 Rule." It is not absolutely exact, but enables the physician to retain the dosage, etc., in mind.

Use ten to fifteen milliamperes, for ten to fifteen minutes, and the hemorrhoid will separate in ten to fifteen days.



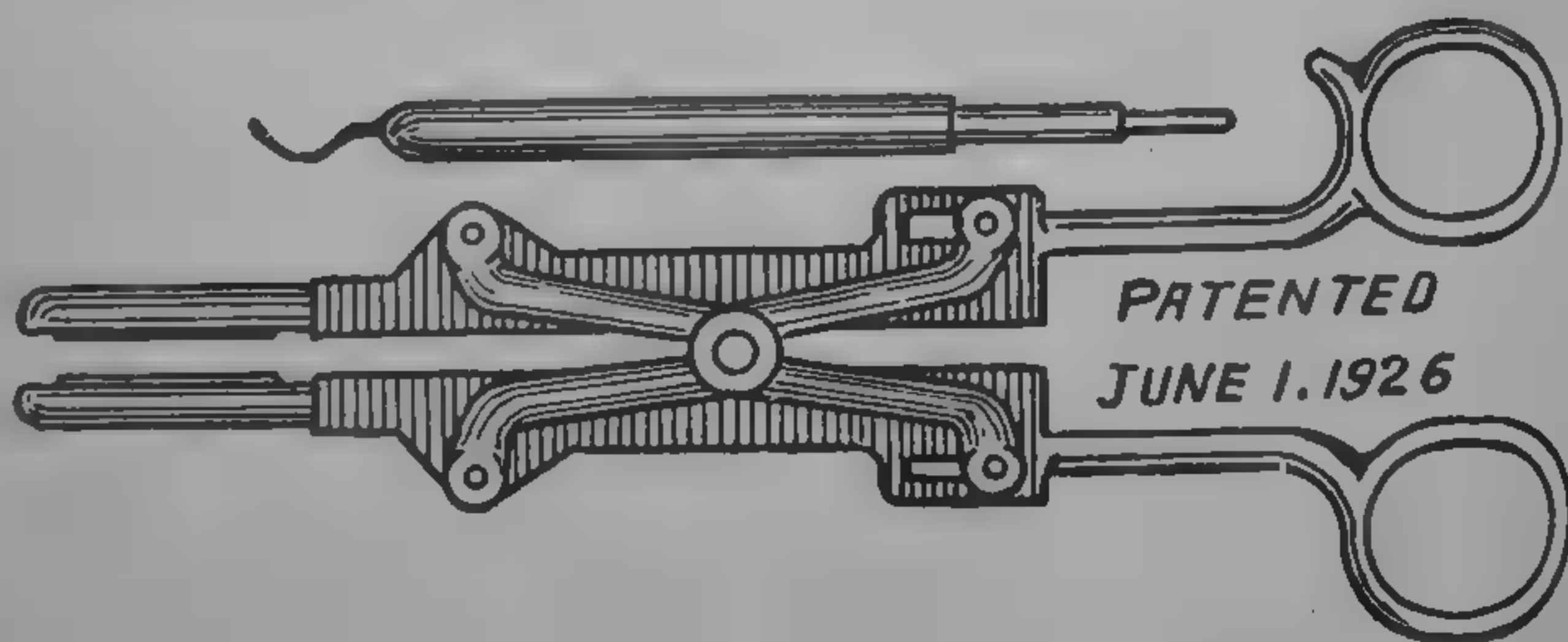
Multatherm for Coagulation and for Use as an Electrical Scalpel.
Portable and Efficient.

As a rule it will come nearer being ten to twelve than it is ten to fifteen, but the ten to fifteen figures are inclusive.

At the end of a week, although the hemorrhoids treated the preceding time, will not have disappeared, the patient

will be in a condition which will make an additional treatment safe and comfortable.

Second. **The Electro-Coagulation Method.** In this case the same needles are used that are used for coagulation of tonsils or elsewhere. The short needle is preferable, and it may be used in several ways. The point of the needle may be inserted in the hemorrhoid and with 300 to 600 milliamperes, the coagulation process carried out; or the blunt end may be used; or the electrode may be bent around in the shape of a buttonhook, and hooked around, or laid flat on the hemorrhoid, with the same coagulating result.



Bierman's Clamp for Hemorrhoids.

It is always important to avoid the base. If coagulation extends into the base, an ulcer frequently forms and when it heals cicatricial tissue forms which is annoying and very undesirable.

With larger tumors the pile may be held with a forceps and the hooked needle placed around (well up from the base, as coagulation will also extend downward), and a zone coagulated through. The hemorrhoid is then cut off at the distal point of the coagulation, leaving the stump sealed with the coagulum, which separates and comes away in 10 or 12 days.

One of the best and most satisfactory methods is the use of Bierman's clamp which limits the coagulation to a narrow strip between the jaws, thus obviating the danger of going into the base. The pile is held by an Allis tissue forceps, the clamp applied (700 to 800 milliamperes for about 1 or 2 seconds), and then the hemorrhoid cut off at upper margin of coagulum as before.

No after care necessary except to keep patient's bowels rather soft.



A Convenient Style Portable Diathermy.

CHAPTER TWENTY-ONE.

Miscellaneous Diseases.

Scope. A number of conditions will be considered under this classification that do not seem to be suitably listed elsewhere.

High Blood Pressure. This is, of course, a symptom and not a disease. Practically in every case it is the result of a toxemia. Toxins circulating in the blood stream cause first spasmodic contraction of the blood vessels, with consequent increase in pressure, and finally, from the oft-repeated contraction, there is afforded an opportunity for secondary changes or sclerosis to take place. The stage before the appearance of sclerosis may be considered as a functional high blood pressure, and all of these cases we should be able to cure through our physiotherapeutic methods. When sclerosis has developed, our success in handling the cases decreases in direct proportion to the amount of sclerosis that exists.

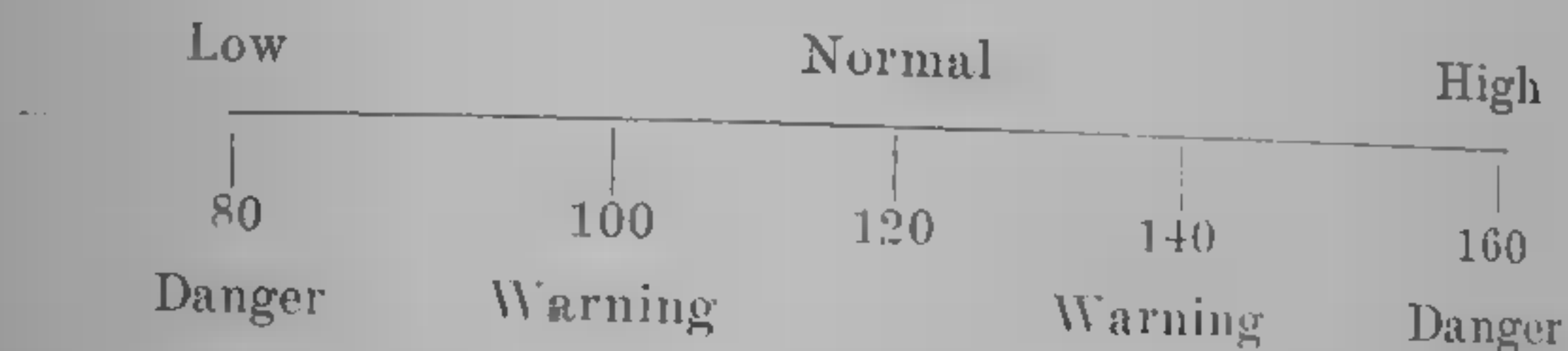
Blood pressure, like the pulse, varies with exercise, food, and whether the patient is standing, sitting or

lying down. Again, when you get the systolic pressure, do not consider that it is an infallible, invariable or fixed reading for that patient. It will vary a few points up or down in the same individual at different times in the 24 hours.

It will be very easy for you to check up on this in a patient who has a systolic pressure of 180 or more millimeters. Take the blood pressure several times during the 24 hours, say after the patient has been resting; after exercise; after eating, and you will find that if you take it four or five times in the 24 hours, you will have four or five different systolic readings. Of course, these variations will not be marked, but they are sufficient that if you were treating a case and took the blood pressure before and after each treatment, you might deceive yourself as to what results you were accomplishing, because you might happen to get the high or the low point for the 24 hours, and thus think you were obtaining improvement or not, according to the reading that you obtained. On this account, unless there is some special reason for taking the pressure, I do not ordinarily do so more than about once a week, generally taking it before the beginning of each week's treatment.

There are many people who suffer greatly as a result of high blood pressure, and on the other hand, there are those who do not seem to have any special symptoms

arising from it, and who are not aware that they have an increased pressure until they go for life insurance or other examination, when it is accidentally found out. In these cases it is very difficult sometimes to persuade the patient that treatment is necessary. They say, "I feel all right, and do not see why I should treat for something which apparently is causing me no annoyance." I have a little diagram which is given herewith, showing the average range of normal pressure, and the borderlines between low and high.



I find that sometimes it is necessary to impress on these patients, where they have passed to what I have called the "Danger point," the fact that they are walking blindfolded on the brink of a precipice, and that it is a matter of sheer luck that they do not make a misstep and be dashed to death at the foot of the cliff. In other words, if the blood pressure is pretty high and they are not experiencing symptoms from it, it is really only a matter of luck that the blood vessels hold and that they have not been subjected to the legitimate consequences of this high pressure.

I have prepared a list of diseases and symptoms in which the blood pressure is high and in which it is low. This table must not be considered as absolutely infallible, because a patient may have at the same time a condition tending toward raising the pressure and another toward lowering it, and according to the one which was exerting the greater effect, would the blood pressure tend.

TABLE.

HIGH	LOW
Arteriosclerosis.	Tuberculosis.
Angina Pectoris.	Addison's Disease.
Aortic Aneurysm.	Aortic Stenosis.
Chronic Bronchitis.	Weak Heart, with Dilated Arterioles.
Cirrhosis of Liver or Kidneys.	Dilated Heart.
Constipation.	Mitral Regurgitation or
Brain Tumor.	Mitral Stenosis.
Meningitis.	Asthma.
Emphysema.	Chlorosis.
Glycosuria (Diabetes).	Hemorrhage.
Gout.	Fever.
Hypertrophy of Heart.	
Lead Poisoning.	
Chills.	
Uremia.	

The treatment of high blood pressure is auto-condensation, in conjunction with hygienic and dietetic measures. Auto-condensation is looked upon by many men using electrotherapy as making no difference whether it be of the Tesla or d'Arsonval type. There is really a



Auto-condensation with Tesla Current.

very distinct difference, and it is important that this be kept in mind to avoid unsatisfactory results.

As these cases are practically all of toxic origin, the treatment should always start with Tesla auto-condensation, using a reading of 500 to 900 milliamperes and an average length of time of about 20 minutes.

The reason for using Tesla auto-condensation is that it is eliminative in character and therefore will tend to increase elimination and decrease the toxicity of the patient. The heat of Tesla auto-condensation is powerful enough to stimulate these functional processes, but it is not hot enough to cause actual organic changes. For the latter the powerful heat of the d'Arsonval current will be required, but if the treatment is started with the d'Arsonval current this powerful heat will liberate toxins in the blood stream faster than the eliminative action of the current can take care of, and therefore the patient will be rendered more toxic by the treatment than before.

In this instance you will frequently find that the patient will be dizzy after a few minutes' treatment, and dizziness, as we know, is the first symptom of intoxication, showing that the treatment has had this effect. Therefore always start with Tesla auto-condensation, and keep it up to the point that the patient is thoroughly eliminating. Then if a stationary period is reached where the pressure does not yield, the indication is that there

must be sclerosis existing in that individual, whether it can be definitely recognized or not, and in order to influence and produce the organic change required, then it will be necessary to employ the intense heat of the d'Arsonval auto-condensation, which is the only form which is powerful enough to work organic changes.

It will be observed that after a treatment with auto-condensation, the blood pressure is reduced about 10 or 12 millimeters. If it is taken again in three or four hours, it will be half-way back to where it was, and by the following morning will probably be nearly to the same point it was before treatment was administered.

What I expect to obtain in those cases which are amenable to these treatments is an average net reduction for each application. When the pressure is above 200 or between 200 and 300, I expect to get an average reduction of about two down to one and a half points; from 200 down to 160, a gain of one and a half to one point; below 160, only a fraction of a millimeter. The nearer you get to normal, the less corresponding reduction is to be expected.

In treating these cases, the treatment at first should be given every day. There is little use to bother with them if they cannot give you the opportunity of frequent treatments at the start. This is one great difficulty that we have in treating these cases. Women particularly

will find that they have social engagements, and miss treatments on that account. If they will not co-operate with you to the extent of coming when you require them, better tell them to go to someone else. It is much better to refuse to treat them than to have them treat with you in a desultory manner and then say that they took your treatments but they did them no good.

Let us now suppose that we have a case with a blood pressure high enough that we would anticipate a reduction of two points for each treatment, and we have treated this patient for one week with the usual dose. We should, therefore, have a net reduction of about 12 points. We take the pressure before the beginning of the second week, and find that our reduction is only ten points or only eight points. In either of these cases we go ahead as before, because the natural variation in the blood pressure may account for the difference between the reading we get and the actual gain that we probably have obtained.

On the other hand, if our net gain showed only two, four or six points, the immediate conclusion is that we are not giving this patient a sufficient dose to influence his case. Under these circumstances, increase the time of giving the treatment by five or ten minutes. In short, find a point in each individual case where the blood pressure can be influenced by the dose that you give. If necessary to take an extremely long treatment such as

an hour you might conclude that it was inadvisable to try to get results in this case and retire gracefully in the beginning.

There are just two things that doctors fail on in applying physiotherapy in high blood pressure. The first is in selecting the proper form of auto-condensation, and the second is in giving an insufficient dose. The dose is always increased by lengthening the time, rather than by crowding the milliamperage.

Providing now that we have a dose that influences the case in hand, we go along with steady progress over a period of time, occasionally having a stationary period, but no prolonged one. Finally we reach a time when elimination is well established in this patient, but the blood pressure becomes stationary and is apparently uninfluenced by a longer treatment. In this case, whether you can find it or not, sclerosis exists, and this is the time to change over from Tesla to d'Arsonval auto-condensation, because that is the only form then that will produce results.

The dose of d'Arsonval auto-condensation is from 800 to 1400 milliamperes.

The progress when sclerosis is present will be much slower than otherwise, but if it is not too far advanced, persistent treatment will still obtain satisfactory results in a reasonable proportion of the cases.

You are not going to be successful in all of your high blood pressure cases by this method. You must not expect the impossible, but if you follow the indications here given in conjunction with your usual measures you will achieve success in a much higher percentage of your cases than you have been able to influence by any other measures.

Some cases of high tension are compensatory in character. In these cases the pressure will come down for a time and finally the patients will say that they feel worse after each treatment. Investigation will show that these individuals have a compensated lesion, and that you are getting the pressure reduced to the point where you are disturbing this compensation and therefore it is better for them to be left with a somewhat high pressure but perfect compensation than to have the pressure reduced at the expense of compensation. Therefore you say to them, "Let well enough alone," and leave them at a point where compensation still exists.

The only other contra-indication of auto-condensation is in the case of low pulse pressure. Pulse pressure is the difference between the systolic and diastolic pressures, and while both pressures usually go down in proportion, occasionally they approach one another, and if the pulse pressure at any time gets down to 20, go slow. Give one more treatment, taking the pressure immedi-

ately after, and if the pulse pressure is still further depressed, say to 18, discontinue the use of auto-condensation and give some sharp sparks up and down the spine to increase the systolic pressure. If you persist you will abolish your pulse pressure, your pulse and your patient.

— Do not forget that the electrode on the patient is of block tin and placed **over the liver**.

Treatments should not be given immediately after a hearty meal.

There are one or two basic points in regard to exercise and diet. They are briefly summarized in two sentences: "Do not over-eat; it kills." "Do not over-exercise; it kills."

Low Blood Pressure. The use of the Oudin current with sharp sparks up and down the spine for five minutes will provoke a reflex contraction of the blood vessels and a corresponding increase in systolic pressure. The Oudin spark is preferable to the Tesla in these cases, because as it has less amperage or heat, a longer spark may be employed and therefore more of the bombardment or mechanical effect of the spark obtained. One of equal length from the Tesla would have a fulguration action wherever the spark struck the skin.

Angina Pectoris. This is one of the diseases in which the use of physiotherapy has lifted it out of the incurable

column and placed it in the list of those conditions which respond to treatment. The method employed is the use of diathermy with a three by five-inch electrode over the base of the heart, and one about seven by ten posteriorly. I use soap lather with the smaller electrode, to insure perfect contact. The dose is about 1200 milliamperes for 30 minutes, repeated daily or every other day. If the case is having frequent attacks, the benefit of the treatment will soon be apparent in lessening the severity, as well as the number of attacks. Aside from any effect on sclerosis, the anti-spasmodic or relaxing effect of diathermy affords relief.

Chronic Interstitial Nephritis. Tesla auto-condensation is employed in these cases, usually giving a 20-minute treatment, in conjunction with diathermy given through the kidneys, with the large electrode to the abdomen and the smaller one over the kidneys. It is easier to treat with the patient lying face downward on the larger electrode, the smaller held in place by a sand-bag. The dosage is in accordance with the size of the smaller electrode. If this is one about 4 x 7 inches, the dose would be 1900 to 2200 milliamperes. The folding auto-condensation pad answers well as the larger electrode.

Diabetes. Tesla auto-condensation for 20 minutes for its eliminative and metabolic action, followed by a

half-hour treatment with diathermy through the pancreas. This calls for electrodes that are about the same size, as the pancreas lies about midway between the anterior and posterior walls. Use electrodes that are large enough to carry a reasonable amount of milliamperes and give the dose in accordance with the size of the electrodes.

The object in using diathermy through the pancreas is for the action that it will have on the islands of Langerhans. In other words, the effect of diathermy will be to have the patient manufacture his own insulin. Usual measures employed in this disease should be followed out in conjunction with physiotherapy.

Case, Crile and others have preferred giving diathermy in many cases by placing each foot in a pan with half inch of water. They also believe in diathermy first to liver, then to spleen and finally to pancreas.

Insomnia. One of the most common statements made by patients who are taking auto-condensation is that it makes them sleepy, and it is not unusual to have them fall asleep during a treatment. Because of this, I determined to try the use of auto-condensation in insomnia, and I consider it essentially a successful method. The treatment should be with Tesla auto-condensation for 20 or 30 minutes, followed by a direct or indirect spark over the supra-orbital region and often to the back of

the head, for about five minutes. If the treatment can be given at a time when the patient can immediately retire it works better, but results are obtained with it given during the usual routine of office work. I have treated many extremely severe cases with absolute results. Of course, attention to accompanying conditions should be given. This will often call for treatment to the splanchnics. The method of using two to five milliamperes of galvanism with positive over forehead and negative over epigastrium is a good one. About 10 minutes or, if the smaller dose is used, a longer time.

Neuritis. Many cases are successfully treated by the use of the Tesla or Oudin spark along the line of the affected nerve. Remember that in cases that are unyielding, that the higher voltage of the Oudin current gives a greater penetration, and that it will in all instances be sufficient to penetrate the sheath of the nerve, which is known to be one of the most obstinate parts of the body to penetrate with electricity. For the average case, there is not much difference whether the Oudin or Tesla spark be employed. In still more severe cases, diathermy is indicated, giving it through the area involved. Naturally, you are looking for the source of focal infection in these cases and eradicating same if it is found. There is one thing to bear in mind in the treatment of neuritis, and that is that frequently the first few treatments cause

an aggravation of the pain. The pain will be relieved at the time of the treatment but as the effect wears off may in its return seem to be intensified. If this is explained to the patients, they will give you the chance of carrying them through this stage, otherwise they may quit you after a treatment or two, under the impression that your treatment is making them worse.

The air-cooled ultra-violet lamp has shown remarkable results in handling some of these cases and should you get a comparatively severe reaction from it, the amount of improvement that will occur with the subsiding of this reaction, will be such that the patient will feel amply repaid for the temporary inconvenience caused by any blisters that you may have produced.

Radiotherapy has proved beneficial also in neuritis and in chronic cases without active inflammation, the negative pole of the galvanic current will relieve. When acute inflammation exists the sedative action of positive galvanism may be employed.

In considering all of the various methods my preference is for diathermy. On page 178 is shown one method of treating sciatic neuritis. Many treat with anterior and posterior electrode.

Neuralgia. This is treated in much the same manner as neuritis. Diathermy is the best method, with localization of heat by the indirect Tesla method a close second.

The heat of the radiant light is valuable, alone or in conjunction with the other measures. Positive galvanism has been employed. Some use it with a weak solution of quinine bichloride on the pad. Others used sodium salicylate on the negative pole.

Anemia and Chlorosis. These diseases are usually satisfactorily handled without the need of employing physiotherapy, but in conjunction with the routine measures, or independently of them, as the physician may choose, we may make use of the benefit of general irradiation with the air-cooled ultra-violet lamp, and also the very marked effect that follows from diathermy used through the epiphyses of the long bones, particularly the femurs. Auto-condensation also tends, through its nutritional value, to be of definite benefit.

Lumbago, Stiff Neck, Myalgias and Other Types of So-Called Muscular Rheumatism. In the treatment of these cases the method which gives the best results is diathermy, and for all severe cases it is the form to be employed. Many of the milder cases will respond to the heat that may be localized over the area with the indirect Tesla method. In former years we got fairly satisfactory results from the use of a sharp spark over the area involved.

In using diathermy in lumbago, the best method is to treat the patient lying face downward on the table, with

the larger electrode on the abdomen, the weight of the patient making good contact. The folding auto-condensation pad will serve nicely for this electrode. The smaller electrode to take in the lumbar area involved is held in place by a sandbag.

The reason for treating these conditions face downward is the ease for making contact with the electrodes, and furthermore, the fact that it is difficult for these patients to get on the table and turn over, where it is comparatively simple for them to climb up face downward.

The dose is in accordance with the size of the smaller electrode, and as this is sometimes pretty large, it is necessary to be sure that the abdominal electrode is definitely larger, so that the heat will be localized in the neighborhood of the smaller electrode; and also it means that a large dose in amperage is frequently given. The average duration of the treatment will be half an hour, but in case definite relief of the pain is not produced in this time, extend it longer. You must in no instance let a patient leave your office who does not admit positive and definite relief from the pain, because you can obtain it.

In the case of the other forms of muscular rheumatism the electrodes will have to be placed in accordance with the area to be reached and in some instances about

the neck. This may exercise your ingenuity considerably. In the wry neck cases about the easiest way is to place one electrode over the trapezius muscle and the other over the chest, and use about 1000 milliamperes of current as an average dose.

During the last two years my experience with infra-red is so satisfactory that I now consider it the equal of diathermy in all of these cases, and its ease of application is an advantage. Half hour treatments, or longer.

Rheumatism or Arthritis. In genuine rheumatism, in the acute stage, the best measures that we have are the use of the indirect Tesla current and the high candlepower lamps or still better, the infra-red. Tesla auto-condensation of course is good because of its effect in increasing elimination. A method which has been quite satisfactory about joints has been to wrap the joint in gauze saturated in a solution of magnesium sulphate and then let the high candlepower lamp shine over this. It is, however, in the chronic cases that we are particularly proud of the results obtained by physiotherapy.

For these cases the treatment is the use of diathermy through the affected joint, followed by the surging sinusoidal current. In treating the knee joint, for instance, the best method is to treat laterally through the joint. The electrodes employed are cut approximately two and one-half to three inches wide, curving slightly to accom-

modate the position of the leg when the patient is lying down, and made long enough, extending above and below the joint, to give a considerable surface, in order that a definite dose in amperage may be put through the electrodes.

An electrode eight inches long and two and one-half inches wide, of somewhat crescent shape, is quite satisfactory, and gives 20 square inches of surface, so that 1500 to 1700 milliamperes of current may be put through without danger of burning.

The patient lies on one side with a small cushion under the knee, which holds the under electrode in good approximation. The other electrode is placed above and held by a sandbag which gives good contact, and at the same time renders easy access to the electrode. (Fig. 51.) The average duration of a treatment is 30 minutes. In some instances it may need to be longer.

The electrodes may be held on with one wooden clamp and rubber sponges.

After the diathermy is used, let the same electrodes remain in place; disconnect the cords from the diathermic poles and attach to the terminals of the sinusoidal apparatus and turn on the surging sine current to the comfortable toleration of the patient and keep it on for five minutes.

This same method is followed in **fibrous ankylosis**,



Fig. 51—Diathermy Applied to the Knee with Two Lateral Electrodes

only that after the surging sine is used, the leg is taken hold of and flexed and extended as far as possible, to the point of producing pain, in order to help break up the adhesions which exist.

The double cuff method of treating elbow or knee, I speak of only to condemn, as the placing of these electrodes is not in accordance with what we understand to be the proper method in diathermy. We do not get a sufficient penetration of the heat; it is superficial only.

The method of placing one electrode above the knee and the other below, and then reversing at a subsequent sitting, is better than the double cuff, but still is not as efficient as the lateral method with the crescent electrodes. For the ankle the use of a single cuff and a large plate, or the water bath is permissible. In the case of **gonorrheal arthritis**, do not forget that the temperature must be maintained well above 104° , as otherwise there may be a flare-up in the case, caused by a temperature that is not well above the thermal death point of the gonococcus. Negative galvanism has been used for the softening and absorption of deposits about the joints, as well as for scar tissue, and also has been tried with the sodium salicylate solution in arthritis. This is all right in chronic, non-inflammatory cases. Where acute inflammation is present, the positive pole will give greater relief.

Bursitis. All forms of bursitis, whether it be the so-called "weeping sinew," on the back of the wrist, housemaid's knee or the more serious type of sub-deltoid bursitis: all of these forms will yield to treatment with diathermy.

In a recent bursitis of the wrist, I have seen it practically disappear under one 45-minute treatment.

For those cases which have existed for some time, it usually takes from eight to twelve treatments.

In the case of sub-deltoid bursitis, especially where there has been calcification, treatment may have to be continued over a period of two or even three months, but all of these cases may be expected to yield to this method.

An excellent technique here is a round solid metal electrode under the arm and the smaller one over the acromial region.

The current is used in the strength of about 75 milliamperes to the square inch of the smaller electrode, and the shortest time is half an hour—longer treatments are often desirable.

Keloid. In treating that annoying form of scar tissue known as keloid, we use fulguration or coagulation for the purpose of destroying the scar. Sometimes it will re-form after the first destruction, usually only about one-third as marked as before. A second or third treat-

ment may be necessary. In very bad cases where there is a great deal of scar tissue, I combine fulguration or coagulation with the use of the X-ray.

The water-cooled ultra-violet to profound reaction has been used and several methods with the use of the galvanic current are recommended, such as positive zinc ionization, or the use of weak potassium iodide solutions on the negative pole. Fulguration or coagulation with or without the conjoint use of the X-ray I firmly believe to be the best procedure.

Cancer. The value of radium and the X-ray in these cases is pretty well understood by the profession. Some cases of cancer have yielded to the use of diathermy. crowded to toleration, and with the treatment kept up from one to two hours over the area involved, on the theory that the normal cells will stand a higher degree of heat than the abnormal. Another use of electricity in these cases has been by means of electro-coagulation with the diathermic current, where the malignancy is entirely coagulated and destroyed by this method, or where it is used to destroy as much as can be reached in cases considered unsuitable for operation. There is one advantage in some cases with the use of coagulation, and that is that it is possible to coagulate an area around the growth which will tend to prevent metastasis. The whole procedure is really a surgical one, and we simply substitute coagulation for the knife or scissors.

The indifferent electrode in these cases is usually about 8 x 12 and strapped to patient's back. The thin folding auto-condensation pad however is very satisfactory. A long aluminum needle in the Plank handle is employed. Dr. Plank has done more of this work probably than any one else in this country. He uses ordinarily for his anesthetic the injection of a No. 1 H. M. C. tablet one and one-half hours before and another three-quarters of an hour before the operation. If additional anesthesia is required, ether is administered. This should be done in an adjoining room and the ether fumes fanned away before using the diathermy, especially if the area coagulated is near the head. This is because the current will produce an explosion if it comes in contact with any volume of ether or ether fumes.

The needle is first used to outline a limiting coagulated wall about the area to be removed and then the whole area coagulated. Some curette and cut away, and others leave the coagulum to separate. This latter requires usually two or three weeks and occasionally longer.

The radio knife or electric scalpel makes an admirable method for removing tissue. It may be used to cut like a knife or coagulate to seal vessels as desired.

Writer's Cramp. For this and all other functional neuroses, the best treatment is the use of the spark from

the Oudin current. In the case of writer's cramp, begin at the fingertips and spark clear up the arm to the brachial plexus. The reason that the Oudin current is superior is because of its higher voltage; it has a greater penetration than the other currents.



Fig. 52—Indirect Tesla Treatment of Frontal Sinusitis.

Then bind a large pad around the arm, just below the shoulder joint, to take in the trunks of the nerves, and place the other pad in the palm of the hand, and

use the interrupted rapid sinusoidal current for five minutes.

Writer's cramp is known by many other similar names—telegraphers' cramp, piano-players' cramp, etc.,—and I have encountered many of these cases in recent years in young men and women who operate adding machines. It occurs wherever the same set of muscles are used over and over again, to the production of extreme fatigue.

Sinusitis. For the treatment of frontal sinusitis and also to a lesser degree for the involvement of the ethmoidal sinuses and the antrum, the indirect Tesla used through the fingertips for the production of as great an amount of heat as the patient can stand, will be found one of the most remarkable treatments that you have ever employed for this trouble. (Fig. 52.)

Numerous cases of frontal sinusitis which have been operated on with unsuccessful results have been cleared up with from ten to fifteen treatments with this indirect method. The average duration of the treatment is about 15 minutes, and consists not only in the localization of heat, but also in the use of a mild spark through the fingertips.

If your frontal sinus is not draining, it will be necessary to see that drainage is established before applying heat. If the drainage is slight but insufficient, you may

increase it by using 1 in 5000 or 1 in 10,000 adrenalin chloride solution on cotton on the positive galvanic pole in the nose to shrink the tissues and open the duct.

The president of one of our life insurance companies had been operated on for frontal sinus trouble about two years previous to the time that he consulted me. During this time the discharge had not stopped, and it was necessary to go to the specialist and have the sinus irrigated at comparatively frequent intervals. Just eleven treatments with indirect Tesla absolutely and permanently cured this case.

Simple Goitre. This treatment is by the use of iodine in some form, driven in from the negative pole of the galvanic current. It is suitable for simple goitre only, and does not apply in cystic or fibrous goitre. I follow the method of making an individual electrode for each case.

I cut out a paper pattern the size of the goitre, and then with it, cut one out of the block tin of the same size, leaving on one side a little strip of the tin about two and one-half inches long. Cover this electrode with wet chamois skin. The piece of chamois should be ample in size so that it covers over the tin, and then the little strip is bent down to hold it in place, which it will effectively do. The clip is then attached to this same strip, which affords a socket for the insertion of the cord passing to the negative pole.

The positive pole is a four by five pad which has been immersed in salt water, applied to the back of the neck. The patient lies back on a pillow so that his weight holds the positive electrode in place. Iodin in some form is then applied either on cotton or gauze over the goitre.

The chamois-covered electrode is then placed over this and a folded towel over the electrode enables the patient with one hand to hold the electrode firmly in contact.

With the patient swallowing, I have found it difficult to hold the electrode by any other measure, and the patient can be taught to make pressure over any area where a stinging sensation is felt, and thus co-operate nicely in the treatment.

If you use iodide of potassium solution, use it in the strength of 10 grains to the ounce. You may use any of the various forms of iodine, and I have also been well pleased with the use of iodex ointment, which I smear over the goitre with the electrode outside of that. The current is turned on to about 20 milliamperes. The more current that you can use, the greater the penetration and speed with which the iodine will travel into the tissues.

No treatment should be for less than half an hour. Remember that iodine travels in by anaphoresis, and very slowly and if you do not appear to be securing satisfactory results, lengthen out the time of your treatment

to as long a period as an hour, because your failure will undoubtedly be due to the fact that you have given an insufficient dose, from the standpoint of time.

It must be borne in mind that there are many who claim that we do not introduce the iodine deeper than the skin, and that the effect takes place from its absorption through the skin and that, therefore, we might get just as much good out of iodine used in other ways. The point, however, is overlooked that there is a definite action on the goitre taking place from the electrolytic action of the negative pole. Treat three times a week.

Ex-ophthalmic Goitre. In treating ex-ophthalmic goitre we have an entirely different problem to deal with. It is desirable where possible, to have the basal metabolism test to guide you.

In my treatment of these cases, I employ first Tesla auto-condensation, using from 500 to 900 milliamperes and giving an average treatment of 20 minutes. During the first five minutes of this treatment with a vacuum electrode held in the hand, I draw out an indirect spark over the thyroid area if possible.

If the current is insufficient, disconnect the cord from the patient to one terminal. This leaves the patient on the connected pad and the indirect Tesla spark is easily drawn. In this way I am giving a general treatment for a constitutional disease, localizing it for certain local

symptoms. Auto-condensation should be given with the patient lying down and in a comfortable, relaxed position. One of the first things he or she will speak of is that they do not feel so nervous after the treatment is under way.

Accompanying symptoms involving other endocrine glands should receive appropriate treatment. I find strophanthin good for regulating the tachycardia, also using the slow sinusoidal current with one pad over the seventh cervical and the other over the solar plexus, giving the current at the respiratory rate, three or four minutes.

The high frequency treatment is given every day in the start, and every week the thyroid area is X-rayed, using from three to five milliamperes in the tube circuit with a fifteen-inch target-skin distance and one millimeter filter and a four-inch back up. A five-minute exposure.

Bordier uses diathermy through the thyroid with a larger posterior and smaller anterior electrode. Claims it controls tachycardia.

Adenitis. Simple glandular enlargement is treated in the same way as simple goitre, using the smaller active negative electrode over the gland and the larger positive pole on the opposite side of the neck. Use iodine in any form.

Torticollis or "Wry Neck." Treatment follows out the method indicated under the section on muscular rheumatism and consists in employing the indirect Tesla for moderate cases, or the diathermic current through the trapezius muscle and the chest for more severe ones. Infra-red seems fully as effective.

Congestive Headaches. In congestive headaches, the quickest relief may be obtained by using vibration over the seat of the pain, keeping the applicator in contact for eight or ten minutes, if necessary, until complete inhibition results.

The indirect Tesla for ten or fifteen minutes is also satisfactory.

Painful Conditions of the Gall-Bladder. In painful conditions of the gall-bladder, with or without gall-stones, definite relief is obtained by the administration of diathermy. A three by five electrode is used over the gall-bladder and another about seven by ten inches posteriorly. Use about 1200 milliamperes for half an hour. Definite relief will often be noted in these cases from a single treatment.

Where there is more or less steady pain about the gall-bladder, relief will follow about the third treatment, and six to eight treatments are usually all that are required for the time being. Later the condition may return and call for another series of treatments.

That gall-stones have at times been definitely disintegrated by the action of diathermy has apparently been thoroughly demonstrated. In the case of mere thickening of the bile, the liquefying action of diathermy is particularly satisfactory.

Renal Calculi. Certain types of renal stones have been disintegrated by the action of diathermy and in other instances where the calculi were small, their passage has been facilitated through the dilating and relaxing action of diathermic heat.

Adhesions. Wherever located, adhesions are treated under the general proposition of softening them by the action of diathermy, and then breaking them up with the surging sinusoidal current.

In the case of adhesions involving the colon or small intestine, the slow sinusoidal current or the superimposed wave also apparently work equally as well as the surging sine.

Electrodes are used through and through in these cases, the smaller one being to the back, as the flexures are nearer the back than the abdominal wall. With the slow sinusoidal current back and front through the hepatic flexure and ascending colon, the patient can feel the pull of the current at the point of the adhesions.

In pelvic adhesions the same identical principle is followed in the treatment.

Use diathermy first for one-half hour and then the sine current for from five to eight minutes.

Splanchnic Insufficiency or Splanchnoptosis. The splanchnic nerves govern the constriction of the blood vessels in the viscera, and when they do not operate as they should the viscera become congested with blood, and there is usually more or less ptosis as well. In a well-marked case, the congestion is such that if forcible pressure is made against the patient's abdomen, a quickening of the pulse will be observed, as well as increased force to the apex impact of the heart. In these cases also the blood pressure will be found higher if the patient is lying down than when standing which is contrary to rule.

The treatment consists in the use of the interrupted rapid sinusoidal current given to produce contractions of the abdominal muscles at the respiratory rate of the patient lying down, which is about 16 or 17 per minute.

One 4 x 6 pad is placed at the lower end of the shoulder blades, which will cover the splanchnic centers.

The other pad may be placed over the lumbar spine or over the epigastrium. The current is turned on until definite rhythmic contractions of the abdominal muscles are produced.

With one electrode on the spine and the other on one side on the abdomen, contractions of the muscles on that side will be produced without disturbing the muscles on the other side.

By using a bifurcated cord and having it attached to two electrodes on the spine, one over the splanchnic and the other over the lumbar centers, while the other cord goes to a large pad over the epigastrium, there may be conjointly treated the splanchnics and the centers for the colon.

This condition of splanchnic insufficiency is found in people who are of a melancholy disposition or have the blues. It is also found in more severe types of mental disease, and wherever present, treatment with the sinusoidal current as indicated, will give marked and definite benefit.

Intestinal Stasis. In constipation or obstipation, the sinusoidal current is the best modality. A large pad back and front to carry the current through the cecum, ascending colon and hepatic flexure using the slow sinusoidal current at lowest rate but to comfortable tolerance of patient for an average of five minutes (occasionally longer). This method has proved effective in incompetency of the ileo-cecal valve.

For general constipation the pads are then adjusted to cover the area of the transverse colon for three to five



Fig. 53—Applying Diathermy through Abdomen.

minutes and finally over splenic flexure and descending colon.

The surging sinusoidal and the superimposed wave are even more powerful than the slow sine in these cases, and recent tests indicate that the alternating sine with sustained peak and the superimposed wave with sustained peak are even better. These are new currents.

With a pad on lumbar spine and a metal electrode in the rectum a good exercise treatment of the latter may be given with the surging sine current.

Colitis. Mucous colitis is treated with considerable success by the use of diathermy through the colon and general ultra-violet irradiation. Colonic irrigation by the Vättenborg or similar systems advised.

Diathermy should not be used in ulcerative colitis, but the ultra-violet may be employed, and topical applications to colon.

Diathermy and infra-red are both good in spastic colitis.

Chilblains and Frost Bites. With the fingers or toes immersed in salt solution in a porcelain or glass vessel attached to one pole, the other electrode conveniently placed, or with two glass dishes, one electrode in each, run the diathermic current up to the point of pain, note the reading and then cut the current exactly in half and continue it for about ten minutes. The use of a piece of

wood planed down on one side to tilt the toes into the solution is a method that has been suggested in treating the feet.

Sprains and Effusions About Joints. The most satisfactory and quickest method in these cases is the use of the indirect Tesla method, using a mild spark, and a localization of the heat through the fingertips over the area for a period of 15 or 20 minutes.

There will be definite and perceptible reduction in the swelling take place during this treatment.

Diathermy also is useful, but the indirect Tesla seems to be more effective.

This same method may be followed for increasing the absorption of extravasated blood. In acute conditions more than a single treatment in the 24 hours is desirable.

Neurasthenia, Brain Fag, Mental Depression, etc. In all of this class of cases coming under various headings, from slight nervousness to pronounced and definite nervous prostration, and from merely having the blues, to pronounced mental cases, the treatment which is employed will always call for the use of treatment to the splanchnics with the interrupted rapid sinusoidal current, as outlined under the heading of "Splanchnic Insufficiency."

In these cases where the blood pressure is low, as is found in most neurasthenics, sharp sparks up and down

the spine will prove of extraordinary value. The high candle-power lamps and the air-cooled ultra-violet will be employed in many cases.

If the blood pressure is above normal then in place of the spinal sparks, use Tesla auto-condensation. The treatment to the splanchnics is in most cases the important part of the treatment.

Post-Operative and Post-Fracture Conditions. In cases after operation, where the vitality of the patient is low and repair processes are going on slowly, they will be stimulated by the use of the stimulative form of diathermy through the area involved.

In the case of fractures where the condition of the patient is such as to make the throwing out of sufficient callus doubtful, or where it has already proven to be the case, the process may be also stimulated by the action of the stimulating type of diathermy.

For this the method indicated, where three, three-minute periods are used, rather than one nine-minute operation, will be found more satisfactory. The point is to decide on what the maximum dose will be in accordance with the size of the smaller electrode (using only 40 or 50 milliamperes to the square inch), and then run the current up to this dose, hold it on for three minutes and abruptly cut it off, and then in half a minute, repeat this same method, for three times in all. Two or

three treatments may be all that is required in a fracture case, and it is possible to overstimulate as well, which should be borne in mind.

Diseases of the Spinal Cord. In all of the various conditions where the spinal cord is involved, locomotor ataxia, infantile paralysis, multiple sclerosis, progressive muscular atrophy, etc., the application of diathermy to reach the spinal cord, is of distinct value. In conjunction therewith, stimulating doses of the X-ray are applied; also to reach the cord.

In **locomotor ataxia**, this method will not cure, but using it in combination with other electrical measures to meet various symptoms, will make the patient much more comfortable.

Certain pseudo-ataxic cases are apparently cured, but the genuine cases are not.

In applying diathermy, to reach the spinal cord we have much more of a problem confronting us than at first appears. The cord is surrounded by bone, and we know that bone is the last structure to become heated through the action of diathermy; consequently, any treatment to be efficacious and really deliver heat to the cord, must be a fairly prolonged one, otherwise the cord will not be influenced at all.

In the second place, close attention must be paid to the individual problem presented by the case, in the way

of adjusting the size of the electrodes so that the maximum heat point shall be in the cord and not away in front of it, as will ordinarily be the case unless care is used.

The spinal electrode should be a long narrow block tin electrode, about two and one-half inches wide, and of suitable length. If you will stop and compute the square inches of surface there are in this electrode, you will realize that it is much larger than it appears, and therefore, the anterior electrode will have to be of much greater area in order that the maximum heat point will be where it is required.

The best way to figure is to consider a cross section of the patient's body, and estimate from where the spinal cord lies, about the width of the anterior electrode, in order that diagonals from the edges of the electrodes, shall cross at the point where the cord is. The auto-condensation pad makes a good anterior electrode.

These cases are best treated lying face downward on the table, making good contact thereby, with the very large abdominal electrode.

The narrow spinal electrode is held in place by sandbags. Use the dosage in accordance with the size of this smaller electrode, say from 65 to 75 milliamperes per square inch.

Let the treatment be at least 45 minutes in duration.

In **infantile paralysis** the treatment should be started three weeks from the onset of the disease.

It consists in applying to the involved sections of the cord, only, the use of the x-ray in about $\frac{1}{8}$ to $\frac{1}{8}$ of an erythema dose, giving a series of treatments and then stopping for about 7 or 8 weeks and repeating.

Diathermy to the spine about three times a week and local exercise of involved muscles with interrupted galvanic and sinusoidal currents.

It is important to let the parents understand that this treatment often requires 2 years and only a few cases are cured in as short a time as 10 or 12 months, and still, if the treatment is persisted in the chances for final recovery are very good.

Bordier has been largely responsible for originating this method and demonstrating its value.

Paralysis. Treatment of paralysis varies, whether the condition is of peripheral or central origin.

In **peripheral**, where there has been pressure on the trunk of a nerve, or where the nerve has been severed, after the removal of the pressure, or the repair of the nerve, the interrupted galvanic current is applied with one pole to the trunk or origin of the nerve and the other over the motor point for the muscle.

Be careful about over-stimulating, and therefore, five or six contractions will be sufficient at first, and in the

case of a recently repaired severed nerve, one or two may be all that can be borne for the first ten or twelve treatments.

As soon as the muscle will react to the interrupted sinusoidal current, it may be employed and the improvement will be much more rapid.

It is to be remembered that a muscle which has so far degenerated that it will not react to any other form of stimulation, will respond to the interrupted galvanic current. When the degree of degeneration is not so marked, it will respond to the interrupted faradic and next to the interrupted rapid sinusoidal. Therefore, if a muscle still responds to the interrupted rapid sinusoidal, it will indicate that the degree of degeneration is slight, and the length of time required to restore the muscle to its normal function will be much less and this form of current may be employed to accomplish the result.

In **central paralysis**, no muscular contraction is sought at first, because the muscles are all right if the central control can be established. Therefore, attention is given entirely to measures which will absorb the clot and tend to enable the muscle to function.

For this purpose, there is nothing better than Tesla auto-condensation. A 20 minute treatment will be of definite value in aiding absorption. During the time this

treatment is given, sparks may be drawn over the area of the affected muscles for the purpose of keeping up the nutrition of these muscles, but no galvanic or any exercise current is to be used.

In addition to the internal remedies which are ordinarily employed in these cases, the use of a mild amount of galvanism using a long electrode over the forehead for the positive pole, and another electrode to the back of the head near the hair line for the negative pole. The hair will have to be thoroughly saturated with soap lather to make it a good conductor.

Bind on the two electrodes with a bandage or towel, and use not more than five milliamperes of current, and for not more than five or six minutes the first two or three treatments, gradually extending the time up to about eight minutes; and if the current is well borne, it may be at times increased to six or seven milliamperes, but that is the limit.

Remember that extreme care must be used in carrying the galvanic current through the brain, and no large doses are permissible. Negative galvanism softens and liquefies, and therefore aids in absorption.

When some time has elapsed with more or less recovery of the use of muscles, but not complete, then the galvanic or interrupted sinusoidal currents may be used locally to the muscles to increase their functional activity.

Also, in these cases where there is a slight trouble remaining, we may very cautiously try the use of diathermy through the head by means of a block tin electrode over the forehead, and one to the back of the head, using plenty of soap lather and give not to exceed 600 milliamperes of current, and at first for no longer than ten minutes.

Diathermy is absolutely contra-indicated at the beginning of these cases, because the effect of it will be to cause a return of the hemorrhage, but after time has elapsed, the liquefying action of diathermy will sometimes enable the absorptive processes to be carried on to a greater degree than has resulted from other measures.

Facial Paralysis. In Bell's palsy, I first use the interrupted galvanic current with the positive sponge, to the back and side of the neck and the negative over the motor points for the various muscles involved, producing about six contractions of each group, about the eye, the cheek and the angle of the mouth.

Repeat the series once. Then use the indirect Tesla method and draw out mild sparks over the whole of the affected side.

With this method, if I get the case within the first two or three days, I expect to have a complete restoration in 30 days. It is advisable, when you get these cases, to have films made of the molars on the affected side, be-

cause not infrequently an impacted wisdom tooth or a badly abscessed molar appears to be the cause of the trouble, and it will be foolish to treat the case without removing this cause.

Infantile Paralysis. This calls for the application of diathermy to reach the spinal cord, in combination with stimulating X-ray doses and the local application of the interrupted galvanic or interrupted rapid sinusoidal current to the affected muscles.

Complete technique given under "Spinal Diseases" in this same chapter.



Solar Arc Lamp.

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